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SCHOOL SCIENCE AND MATHEMATICS

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SCIENCE TEACHING IN A DEMOCRACY.[1]

BY EDWIN E. SLOSSON,

Director of Science Service, Washington, D. C.

The aim of the scientific investigator is to reduce the raw material of nature to a compact, impersonal and permanent form, to extract from millions of miscellaneous facts a single and simple formula that is applicable to all similar cases. It is by means of this method that modern science has made such unprecedented progress.

But in freeing science from all traces of the historic and human alloy that has accumulated in the course of its development its human interest has been lost. It requires long training to appreciate the significance and beauty of a mathematical formula. This depersonalized science is necessarily less attractive to the layman than literature, art and history with their predominant personal element.

Therefore if we want to interest the unscientific mind, of either adults or children, we usually have to re-introduce the human element that has been so sedulously eliminated from abstract science. This may best be done, in my opinion, by showing how science influences the life and thought of the world in the past, present and future. In regard to the past this means a rewriting of the history of the world from a scientific standpoint. Not the mere "history of science"; not the rehearsal of the crude guesses and mistakes of the pioneers of science; not the tracing out of all the blind alleys into which they have entered in their search for the one true way out of the maze; not the cultivation of admiration for their aims and achievements. There is no reason to think that Pasteur or Roger Bacon takes any pleasure in our celebration of his birthday. But what needs to be brought

[1] An Address to the National Association of Secondary-School Principals at Chicago, February 27, 1924.

out is how a single scientific discovery may transform everyday life, industrial conditions, international affairs, and the prevailing mode of thinking. The same thing can be shown in regard to the present and the future.

Scientists have hitherto been too modest and too humble in claiming credit for what they have done and can do in the control of human affairs. They have allowed statesmen, writers anl financiers to take all the praise for advances in civilization and the amelioration of living conditions that were really due to scientific research. Scientists have hitherto been content to serve mankind without attempting to guide it. They have provided new powers for destruction and construction without saying how they should be used. I venture to say that in the future science will have something to say about the conduct of life, as well as provide the means of living.

The world, like a child at Christmas, accepts with pleasure, if not with gratitude, the material gifts of science, metals and movies, railroads and radio, foods and fine raiment. But the world turns a deaf ear when science would talk about peace, order, economy, foresight, efficiency and the frank facing of facts.

The practical and industrial value of science, on which Bacon had to insist so strongly three hundred years ago is now acknowledged by all. The value of research is generally recognized. What most needs emphasis today is the human side of science. The world needs to understand what scientific training does to the mind of man.

The antagonists of scientific education do not question the achievements of applied science, they do not object to the pursuit of pure science, they do not deny the practical advantages of elementary scientific education. What they do question is the aesthetic, intellectual and moral benefit of scientific training; that it can stimulate the imagination, broaden the sympathies, clarify the mind and elevate the character. In short they challenge the cultural value of science. Music, we know, has a value to those who are not musicians, architecture to those who are not architects, poetry to those who are not classical professors. Has science any such value to those who are not its professional practitioners? This is what was to be demonstrated and has not yet been demonstrated to the satisfaction of the world at large. It must be admitted that some of those who have taken scientific courses with A grades do not show in their character and mental attitude evidence of such beneficial

effects from the information acquired. It is of course admitted on the other side that some classical students never get an inkling of the cultural value of their studies, though if I ventured to give any figures as to the percentage I should get into trouble.

It is partly because science teachers have neglected the humanistic side of scientific studies that we now again hear demands for a return to the "humanities," meaning mostly by that the atrocities of the Trojan, Gallic and Peloponnesian wars. But however we may think the two types of studies compare in regard to intrinsic and possible cultural influence it must be acknowledged that classical and literary studies are more commonly taught with a view of exerting such influence, while this side of the science is frequently ignored in the class room and unappreciated by the world outside.

Not long ago I was in the study of the head of the biological department of one of our colleges when he said to me: "You are going about the country a good deal, can't you help me get a professor of zoology?"

I replied that that ought to be easy.

"No," he said, "I have been trying to find one for the last three years. You see I want a zoologist of very unusual qualifications."

"What sort of a man do you want?" I asked.

"I want a professor of zoology who knows something about animals. But the universities don't seem to be turning out such nowadays. I can get a man who knows all about the hydrogen ion concentration of the blood or who can count the chromosomes or who is familiar with museum specimens but they do not seem to be acquainted with animals that are alive and whole."

So it seems that the present policy of specialization, marvelously successful as a method of research, has been carried so far as to remind one of the study of the elephant by the blind men. The one who touched the side reported that the elephant was "very like a wall." The one who embraced the leg concluded that the elephant was "very like a post." The one who was engangled in the trunk said that the elephant was "very like a snake," and so forth. These investigators were all quite correct, yet it would have been better if they all could have got a glimpse of the beast as a whole before beginning their specialized researches.

So, too, it seems to me advisable to give our pupils a glimpse of nature in its wholeness before we begin to partition it among

the several sciences. It is the custom at hotel dinners to bring in the roast turkey or the planked steak and exhibit it in its entirety to the guests before it is carved up into portions for the particular plates where it is to be still further reduced by each to masticable morsels.

The slicing up of a subject into separate sciences is as necessary a preliminary to its complete assimilation as is the carving of a turkey. But both processes are irreversible reactions. It is difficult to get from the consideration of hash an integral idea of what creature supplied the meat.

So it is too much to expect that students who are kept exclusively to the study of dissected subjects should be able unaided to reconstruct the complete original. We should at least allow them a glimpse of it before we cut it up for them. The whole is equal to the sum of its parts, but the summation process is difficult, quite beyond the intellectual capacity of many of our pupils who therefore pass through life without ever having reconstructed the unity of nature out of the diversity of the curriculum. Their map of the world is a dissected map and they do not always realize that the world is a whole and that the divisions are, like the boundary line of countries, the arbitrary and artificial inventions of man When we look at a map of Europe the parti-colored countries look as natural and immutable as the mountains and rivers. Yet we know that their boundaries are accidental, due to the fortunes of war and royal marriages. France, Germany, Belgium and Italy are now very definite entities, yet it might easily have happened that none of those names should appear on the modern map. We might see instead such names as Normandy, Burgundy, Brabant and Savoy, which would in that case appear to us as the natural and inevitable nations. Or if Charlemagne had had only one son we might see today Germans and French a single people, unitedly resisting any attempts to dismember their nation.

So, too, it might have happened that there should be no sciences by the name of chemistry or biology, paleontology or sociology, and yet the fields covered by these well defined and self-conscious sciences might have been quite as thoroughly cultivated as now. It was natural and inevitable that science should split up into sciences as the Europe should separate into nations. Yet the existing divisions are not natural and inevitable, but are largely accidental and altogether artificial. There are no lines in nature, as the artists learned long ago.

A plant does not belong to botany exclusively. It belongs as well to physics, to chemistry, to astronomy, to meteorology, to dietetics, to economics, to esthetics, and other sciences too numerous to mention. All the sciences have an undivided interest in the living plant, but if any one tries selfishly to separate its share all it gets is a lifeless abstraction.

These are obvious observations but they are not trite. I have heard faculties wrangle for hours over whether a student had taken a properly balanced course, meaning by that so much botany, so much zoology, so much chemistry and so much physics This is much the same as if they had insisted that the student spend so many hours east of the 100 meridian and so many west of this imaginary line. Their aim is to insure that the students get various forms of training but this cannot be told from the classifications in the catalog. According to this all chemistry courses are counted the same but Chem. *II* may be laboratory work, teaching handiness of the hands like manual training, while Chem. *XIV*, dealing with the mechanics of the atom, is a branch of higher mathematics.

The separate sciences, like the separate countries, have now a real and definite existence, however accidental their origin, and their divisions cannot be ignored, however artificial and confusing they may be. But the more the nations multiply the more need for internationalism. The more the sciences proliferate the greater the necessity for emphasis on the unity of the organism. Europe with its dozen new countries is said to be suffering from Balkanization. Some of our students suffer from Balkanization of the brain.

This is not due to an overdose of specialization but to a deficiency of generalization. It is particularly important that the growing child get the vitamin of generalization. Kindergartners used to think that because children had little fingers they should be set at fine work. Nowadays the theory and practice is reversed; the larger muscles are used first. Children begin by writing on the blackboard where they can use the whole-arm movement. The mental development seems to follow the order of the muscular, starting with whole-arm movements of thought and coming down gradually to the minutest investigation. The early years of adolescence are the period of sweeping generalization, of cosmical theorizing, of wild speculation, of unbounded ambition. Doubtless this tendency of the adolescent mind to enlarge its orbit has to be held in check lest it run off on a tangent and arrive nowhere. Yet like other natural tendencies it should

be guided rather than thwarted. A study of the biographies of great scientists shows that many of the most important revolutionary generalizations of science have been conceived in youth, often in the latter teens or early twenties, though it required a lifetime of labor to substantiate them. One of the factors in scientific progress, the free formation of bold hypotheses, is allied to the creative capacity of the artist, musician, or poet, and normally appears at the same early age.

When the tourist comes into a strange city he generally takes the first opportunity to ascend the highest building in the place. The Washington Monument, the Woolworth building, the Eiffel tower or the Venetian campanile, to get a bird's-eye view of the whole city before he begins its study in detail. It cannot be denied that such a preliminary survey may correctly be called superficial. From such a height nothing is distinct and much is hazy. But if the stranger does not get such a general idea of the city at the start he is never likely to obtain it later by any process of combining his close-ups of individual squares and buildings.

The study introduced into the schools some years ago under the title of "General Science" was designed to give the student such a bird's-eye view. It has become established in the curriculum, but it has not altogether fulfilled the expectations of its promotors. I cannot say who is to blame. The teachers say that it is the fault of the text-books. The text-book writers say it is the fault of the teachers. But in either case the fault lies in the fact that General Science has not yet quite found its field and that it is apt to be a collection of samples of the several sciences instead of a scientific survey of nature as a whole. The subjects tend to fall apart along the cleavage planes of the conventional classification of the sciences which are to follow it.

If General Science is to retain an honored and useful place in the schools it must maintain its own point of view, which is as legitimate as that of the several sciences. It is simply a question of the method of attack. There are two ways of cutting up a jelly-cake. One is horizontally, taking off layer by layer from the top to the bottom. The other is to cut down perpendicularly through all the layers. You get just as much cake in the latter case as the former, and even a thin slice from top to bottom gives you a better knowledge of what the cake consists of than you can get from the most thorough mastication of a single layer. "A little knowledge is a dangerous thing" only when what little is known is inaccurate, indefinite or overestimated.

I have heard it said that no one person could know enough to teach General Science. But if that is true, no one student is capable of acquiring it. There is admittedly a limit to the capacity of any human cranium but what it shall be filled with is a matter of choice. "Study one thing thoroughly" is good advice, but what is the "thing?" May it not be a plant, an ant-hill, an automobile or a house, as well as the chemistry, the mechanics, the sociology or the microscopy of these and all other things? Aristotle or Alexander von Humboldt did not know so much about any one science as a Grade C graduate of a modern college, but neither could be called "scatter-brained" or "shallow-pated." I feel sure that either Aristotle or Humboldt, if their information were freshened up a bit, could teach high school General Science in a way to win the respect of a university specialist.

The latest survey of science teaching in the secondary schools of the United States, that made by Dr. George W. Hunter of Knox College, shows that General Science is coming into the first year of the four-year senior high school, Biology in the second year and, usually, Chemistry in the third and Physics in the fourth. Teachers of the special sciences report that General Science, properly taught, aids their work by laying a broad foundation and serving as an orientation course at the entrance of the high school.

Formal learning is a tool. Its value depends on what is done with it. Give a jack knife to a boy and he may whittle wood or cut his fingers with it. The knife is neutral. Much of elementary education must be merely formal, the giving of tools to children. The three R's are nothing in themselves. They are merely the keys to the knowledge of good and evil. Whether they prove beneficial or injurious to the student depends on what use he makes of them. Reading the wrong books may make a man worse than an ignoramous. Learning writing may qualify him for forgery and learning arithmetic for swindling. The value of a ship's load cannot be calculated by the inspection of the Plimsoll mark. The value of an education depends more on the character of the cargo than on the capacity of the craniun that carries it. Neither an information test nor an intelligence test can determine what the man's mind will be worth to the world.

In repeating these hackneyed observations I am not presenting an argument against the alphabet, but I am pleading for ts

proper employment. Illiteracy is always a bad thing but literacy may be an evil thing. I mention this here because educators, like everybody else, are apt to become so absorbed in methods that they do not think enough of results. Means always tend to overshadow ends. We need to pay more attention to what people read after they get through reading their readers. Opportunity does not nsure progress.

Christian missionaries like Livingstone rejoiced over the opening up of Africa by commerce and communications because they naturally and naively assumed that it meant the spread of Christianity. On the contrary it led to an unprecedented spread of Mohammedanism, their most formidable foe.

If science teachers merely teach their students to use the appliances of science and fail to train them in the scientific way of thinking they may find the intellectual aims of science defeated by the machinery of science. The printing press contributes to the spread of superstition and obscurantism as well as to the spread of science. The newspapers publish a lesson in astrology more often than a lesson in astronomy. In our books and magazines fiction vastly outweighs fact. By means of the radio Voliva's argument for a flat earth is broadcast from Zion City all round the world.

Science teachers in the secondary schools occupy a strategic position for influencing the thought of the nation. They give all the instruction in science that most of the people ever get and they have the first chance at those who go on to the university Upon such science teachers therefore rests the responsibil ty of presenting science in the beginning in its integral and humanistic aspects. I venture to say that such a presentation gives the best foundation for future specialization and abstraction.

The science teacher has a double duty: (1) to train the student in a new way of thinking and (2) to acquaint him with the mass of facts and laws that science has acquired, to see that he gets his share of the inheritance of the accumulated wisdom of the ages. No one can appreciate the aim and achievements of science unless he has had some practice in the experimental processes by which scientific principles are discovered and established. Otherwise he will not be able to distinguish between genuine scientific discoveries and its pseudomorphs, the fakes, in after life. He will not know how to distinguish the man who knows from the man who pretends to know. This

ability is more important in a democracy then anywhere else. The danger in an aristocracy is that the people will respect and follow those that are not worthy. The danger in a democracy is that the people will fail to respect and follow those who are worthy of such confidence. Envy of the expert is a common human failing. We none of us are free from the desire to look down on those who have the right to look down upon us. We all of us take a secret delight in the humiliation of our superiors and we rejoice in disclosing the ignorance of those who know more than we do. This natural human weakness becomes a public menace when it is multiplied by a million. It accounts for the votes cast against Aristides the Just and for the disposition to elect as our representatives not the leaders of men but average men. This does not matter much in ordinary political affairs, for politics is not yet a science and there are many ways of reaching the same result. In science there is only one truth but an infinitude of falsehoods. A problem has a single solution. An unwise popular vote on a political question may bring a temporary calamity upon a nation, but an unsound popular opinion on a scientific question may bring permanent ruin to a race. It would not have mattered much if the legislature of Indiana had passed the bill fixing a fictitious value of Pi, but it would have made lots of trouble if the engineers and mathematicians of the world had adopted the wrong figure. The fate of the nation depends less on how the people cast their ballots than on how they combine their chromosomes. If one of your pupils should become president, you would properly take pride in it but you would not have benefited the nation nearly so much as if you should train one of your boys so that he could discover how to kill the corn-borer or make synthetic gasoline. For whoever is president, the corn-borer keeps on boring and the gasoline keeps on burning.

The main object of education in a democracy is not to teach the students how to vote right, but to train them how to think right. Under any form of governemnt, in an autocracy no less than in a democracy, the real power lies in the people, and it is their individual conduct, guided by their personal beliefs, that determine whether the nation shall advance, stagnate, or retrograde. The most and the best that any government can do to control the destiny of the nation is to provide a system of education such as will insure that every child has a chance to learn whatever is known about the world he is to live in and the consequences of his conduct.

A CRITICAL RATING OF BIOLOGY TEXT-BOOKS BASED UPON THE CARDINAL AIMS OF EDUCATION.

By R. E. KLINGENSMITH

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and

G. I. GIARDINI

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The aim of education is to furnish skill in conducting the activities of life and in applying attitudes to these activities. It should also give the reason or science back of these and furnish a thorough understanding of all their individual and social implications and relationships. All studies will not do this in equal measure, else there would be no need of a differentiated program of work.

It is our purpose to attempt an analysis of the extent to which Biology in the high school attempts to further these ends and with what degree of success this subject meets the demands made upon it.

As it is not practical for us to measure to what extent pupils that have studied and study Biology in our high schools have acquired skill in conducting life's activities, or to what extent teachers of Biology have succeeded in inculcating biological knowledge and methods that would furnish such skill, the only data available for our problem are the analyses of the Biology texts now used in our high schools. We, therefore, shall attempt to make out a score card for rating textbooks on the subject. Of course, our score card, like all other score cards, is to a great extent arbitrary. There is no standardized score card of which we know.

In the card which follows the different items are given certain weight according to their relative importance as is in accordance with our experience and that of others.

	Assigned Rating
A. Method:	
1. Subject-matter presented as Biology, not as special science	10
2. Method of approach psychological	10
3. Tendency to create attitudes and perspectives that are ethical, thoughtful, cooperative, healthful, cultural	15
Total	35
B. Contents:	
1. Material within pupil's grasp	5
2. Related to life activities	
a. School life	1
b. Home membership	6

c. Citizenship	6
d. Vocation	2.5
e. Leisure and recreation	1
f. Personal health	10
g. Religious or moral	1.5
3. Amount of material—essentials not omitted	5.
4. Stimuli for further acquisition of knowledge	3.
5. Scientific accuracy	1.
Total	42.0
C. Mechanical perfection:	
1. Style	5.5
2. Print	3.
3. Illustrations	2.
4. Index	2.
5. Table of contents	1.5
6. Construction	2.
Total	16.0
D. Arrangement:	
1. Continuity	5.
2. In relation to availability of illustrative material	2.
Total	7.0

We have chosen such texts as are representative of the changing ideas in the method of presentation and attack. The reader will note that the latest books differ quite radically in these two respects from those published some years ago. The general outlook of the authors of Biology texts seems to be moving from the anthropomorphic to the anthropocentric.

Following is a list of the texts arranged, for convenience, according to the date of their publication.

Name of Text	Author	Publisher	Year
A. Elements of Biology	G. W. Hunter	Amer. Bk. Co.	1907
B. First Course in Biology	Baily & Coleman	Macmillan	1909
C. Intro. to Biology	Bigelow	Macmillan	1914
D. A Civic Biology	G. W. Hunter	Amer. Bk. Co.	1914
E. Civic Biology	Hodge & Dawon	Ginn & Co.	1918
F. Elementary Biology	Gruenberg	Ginn & Co.	1919
G. Biology for High Schools	Smallwood & others	Allyn & Bacon	1920
H. Biology for Beginners	T. J. Moon	Holt and Co.	1921
I. Civic & Economic Biology	W. H. Atwood	Blakiston's Son	1922
J. Biology of Home & Community	Trafton	Macmillan	1923
K. New Essentials of Biology	G. W. Hunter	Amer. Bk. Co.	1923
L. The Biology of Man and Other Organisms	H. R. Linville	Harcourt Brace Co.	1923

Our evaluation of these texts is principally from the standpoint of their intrinsic merits regardless of what the teacher might supply in making them more useful. Our question is: How much can a pupil get from any text without the aid of the teacher or of supplementary material? A good teacher can supplement a poor text in such a way as to make the course quite

successful. Our second question is: To what extent do the texts conform to the Aims of Education in general and of Biology in particular? As the Aims of Education we have accepted the principles as set forth in the report "The Cardinal Principles of Secondary Education" of the Commission on the Reorganization of Secondary Education of the N. E. A. For the specific Aims of Biology we have accepted those as stated in "A Proposed Course of Study for Chicago High Schools," namely, that Civic Biology is, "designed to acquaint the student with the facts of his physical environment as it modifies and molds human life, and with the facts of life and his position in the life sequence." Elsewhere in the same report, we find the statement, "The Committee feels the increase of emphasis on health and physical welfare justifies the increase from three periods per week to five periods." The health aim we have taken as one of the specific aims of Biology, if not the specific aim.

We based our evaluation upon four main items, namely: Method, Content, Mechanical Perfection and Arrangement of Material. These items have been subdivided and each has been evaluated as shown in the score card.

The mechanical perfection, altho very important, has been standardized to such an extent by text-books publishers as to affect very slightly the relative evaluation of the texts. For this reason we have weighted it comparatively low.

We may dismiss the consideration of arrangement of material by simply saying it should be based upon some logical sequence determined by the seasonal changes in general and illustrative material available during those seasons. We must not neglect, however, that there must be also a certain psychological sequence, i. e. the simple should precede the complex.

In regard to method, we feel that the presentation of Biology as special sciences such as, Botany, Zoology, Physiology and Hygiene has no justification in nature and therefore no place in the life of the pupil. All four of these branches may be involved in a single biological problem.

The question of method of approach is naturally closely related to the first item. The principal reason for which we insist that Biology should be presented as Biology and not as separate sciences, is because it is the natural and therefore the psychological way of presenting it. But this second item is meant to cover more than this. It asks whether each section of the book, each chapter, each principle or idea is developed in a way which is natural to the child of high school age. In the

past, the method of approach has been primarily deductive, beginning with set principles and leading to the facts upon which these principles were based. The present tendency is to begin with a problem, securing an abundance of data which, upon analysis, will suggest a solution. The biological principles should be established from evidence thus treated. It should be the author's aim to so present his material as to make the pupil feel there is a problem to be solved. This procedure is of value in that the activity of the pupil is as nearly self-motivated as may be conceived. The problem is not imposed upon him, but rises out of the needs the author has brought within the pupil's consciousness.

Other things being equal, most texts are cultural, ethical and certainly not unhealthful, but they are so only passively, if not negatively. On the other hand, few are the books that, because of the way they are written, create in the pupil that dynamic, thoughtful, co-operative attitude so necessary to a progressive citizen. The usefulness of an individual in a community is largely dependent upon the attitudes he has toward life in general. A book that, by its own nature alone succeeds in making individuals more rational in their outlook towards things, beings and events is surely more valuable than the text depending upon the teacher for the attainment of such end.

In the analysis of content we have omitted consideration of laboratory equipment and problems because most of the texts treated have separate manuals for this purpose. We have considered, however, whether or not the material is within the pupil's grasp and is related to his life activities. In the case of the former it may seem that we have given it a rather low rating. But remembering that style, under mechanical perfection, is an important factor contributing toward making a text understandable, the value is double what it appears to be. Moreover, the amount, as well as the lack, of necessary material has been considered. We have not evaluated this item highly because we have assumed that if the child is not interested in any part of the book he will eliminate it. But, again, the extent of the elimination will depend upon the method of approach used and the style employed.

Another item we considered of importance is the means employed by the author to stimulate the pupil to the acquisition of further knowledge. Exercises, problems and suggestions at the end of each chapter are of value for this purpose. Prob-

lems at the beginning of each chapter, or introducing chapters with problems are good for stimulation of interest.

No material ought to be included in a text that is not, in some way, connected with past, present and future activities of the pupil. In the second item under contents we have laid down the aims of Education and determined which of these Biology ought to particularly emphasize. It ought to contribute primarily to health in all its personal and social aspects. Health is the common ground upon which people of all classes and creeds meet. All individuals of all social strata are interested in health, first individually and then socially. Further, Biology ought to contribute to an efficient home membership and citizenship. Secondarily, it ought to contribute to other life activities of religious and moral types, towards leisure and vocation. It ought, in some way, to influence school life as a composite of these activities, a period not only of preparation but of actual living,—a period of vocation for the boy and girl. Until a child leaves school his vocational life has all been pointed to the future. Why not, as Prof. Brewer has suggested in lectures, consider his school life as his vocational life. All the activities then are vocational for the period he is in school, since it is the school's job to promote efficiency in the activities of life. Apart from this, Biology is foundational for many vocations and a host of leisure pursuits. It is of great worth for a text to point this out in an effective way. We do not suggest, however, a "Vocational Biology," to correspond to our "Civic Biology" and "Biology of Home and Community."

In the table which follows we have denoted the items by using the same symbols used in the score-card. For instance, when the second item under Method was considered it was designated as A2; the third item under Content would be B2a, etc. The letters A, B, C, at the top, refer to the texts as listed above.

It is evident from the table that the more modern texts meet our requirements best. Books like Baily and Coleman, Moon (a recent book), Hunter's Essentials and to a great extent, Smallwood, Revely and Baily are excellent compendia of biological facts classified and organized according to adult reasoning. Of the four, the last perhaps succeeds best in vitalizing the contents by employing a method of presentation more suitable to children of high school age.

Bigelow's book stands between the old type represented by the four above and the modern type which follow. Bigelow, to a certain extent, breaks away from the stysematic treatment

and recognizes that the purpose of Biology in the high school is to provide the future citizens with knowledge concerning the maintenance of ndividual and civic health, primarily.

	Asg'd Rat'g	ACTUAL RATING											
		A	B	C	D	E	F	G	H	I	J	K	L
A1	10.0	2.0	2.0	4.0	8.0	7.0	10.0	2.0	3.0	8.0	9.0	6.0	6.0
A2	10.0	4.0	3.0	6.0	6.0	8.0	8.0	5.0	3.0	5.0	6.0	6.0	6.0
A3	15.0	2.0	2.0	5.0	10.0	12.0	12.0	2.0	5.0	10.0	11.0	10.0	10.0
B1	5.0	4.0	1.0	3.0	3.0	4.0	4.0	5.0	4.0	2.0	4.0	3.0	4.0
B2a	1.0	0.0	.5	.1	.5	.5	.5	.3	0.0	.4	.7	.5	.5
B2b	6.0	.8	.8	4.5	4.0	5.0	6.0	.8	2.0	4.0	5.0	4.5	5.0
B2c	6.0	.8	1.5	4.5	4.5	5.0	4.5	4.5	3.0	6.0	6.0	4.5	6.0
B2d	2.5	.2	.2	.2	1.0	1.3	.8	2.0	.4	1.0	2.0	.5	1.5
B2e	1.0	0.0	0.0	.1	.2	.5	.2	.2	.1	.1	.8	.5	.5
B2f	10.0	3.0	3.0	10.0	10.0	7.0	10.0	6.0	4.5	8.0	7.5	10.0	9.0
B2g	1.5	0.0	.3	1.0	1.0	1.0	1.0	.8	1.0	1.0	.8	1.0	1.0
B3	5.0	2.5	4.0	1.0	2.5	1.0	4.5	4.5	4.0	4.0	4.5	3.0	4.0
B4	3.0	0.0	.5	0.0	.1	0.0	0.0	2.0	2.0	2.0	2.0	1.0	0.0
B5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.9	1.0	1.0	1.0	1.0
C1	5.5	3.0	2.0	3.0	3.5	4.0	5.0	4.0	3.0	4.0	3.5	3.5	5.0
C2	3.0	2.0	2.1	2.4	2.4	2.4	2.4	2.0	3.0	2.0	2.3	2.0	2.0
C3	2.0	1.3	1.3	1.0	2.0	2.0	2.0	1.9	1.3	2.0	2.0	2.0	2.0
C4	2.0	1.3	1.0	1.3	1.5	1.5	1.5	2.0	1.0	1.8	.7	1.7	1.5
C5	1.5	1.5	1.3	1.4	1.5	1.3	1.4	1.2	1.0	1.4	1.1	1.5	1.5
C6	2.0	1.4	1.4	1.6	1.5	1.6	1.6	1.7	1.8	1.8	1.5	1.5	1.5
D1	5.0	3.0	3.0	3.5	4.0	3.0	5.0	3.0	3.5	4.0	4.0	4.0	5.0
D2	2.0	.8	.8	.8	1.8	.8	1.8	1.0	.8	2.0	1.2	1.8	1.5
Tot.	100.0	34.6	30.9	57.7	72.0	69.9	83.2	52.4	48.3	71.5	76.6	69.5	74.5

Hunter's "A Civic Biology" takes a step further in the same direction. In places, however, the author has succeeded only at the expense of some unnecessary repetitions and some rather incongruous sequences. In his new contribution ' New Essentials of Biology," Mr. Hunter has avoided the incongruous repetitions referred to, but in doing so he has fallen back upon the orthodox logical order, altho not quite so distinctly as in his "Elements of Biology." He should have written "A New Civic Biology" instead of "New Essentials of Biology."

Atwood's "Civic and Economic Biology" strikes one with a profusion of good cuts and a wealth of useful information, although in many instances it is pure science. The one fault with this text is that there is no impression of problem for the reader to solve. Although he starts with a question, it is not designed to promote the spirit of inquiry. Rather, it is followed by a ready made answer in such a fashion as to remind one of the catechism. In other words, the approach is unpsychological and at times, at least, the materia! and style are too difficult.

In Linville's "The Biology of Man and Other Organisms" we are again struck by the great wealth of material. The text would be nearly complete without the first half,—and far more interesting. We doubt very much whether a youngster of high school age would read very far through the first half of the book, in which the author treats of systematic zoology, pure and simple, starting with the Protozoa and ending with Man. From there on we have Biology, written in attractive style, with a somewhat problematic approach and a broad utilitarian outlook. That part of the book dealing with the improvement of the human race is particularly commendable.

The three books that are left represent three extreme viewpoints. In Gruenberg we have a treatment principally anthropocentric. His idea is to place in the hand of the future citizen the means by which he can control his environment. To attain this end he employs a method which seems entirely illogical and fragmentary to the old type systematist such as a great many of our teachers are, but which is entirely in accordance with the methods of thinking of immature, untrained minds.

Trafton takes the economic viewpoint, emphasizing the conservation of resources. The method of treatment is objective rather than subjective with the fundamentals barely touched upon in a casual way. He emphasizes, however, two of the main items for which Biology should be taught, namely, Health and Citizenship.

Finally, in Hodge and Dawson we have the problem method of attack In fact, the book consists of a consideration of a few vital problems object vely treated. The great omission in this book is that nothing is given to the pupil concerning the care of his body. Perhaps the authors have taken the view that as long as the objective environment is properly controlled no such knowledge is necessary. This is true only in so far as it practicable to effect such a control. As long as we are dependent upon our environment we are patent to its evils, and since so many factors are envolved in the attainment of an effective total control, we ought to know how to cast those evils off after we have acquired them.

This does by no means represent an exhaustive study of the text-book problem, but merely presents it. The present study shows that we are getting away from the idea of teaching Biology as systematized sciences like zoology, botany, etc., and are approaching a method of presentation and attack which is more suitable to the children's understanding and method of thinking.

THE SCIENTIFIC TURN OF MIND.

By Wilson C. Morris,
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Science teachers differ greatly, I dare say, regarding the aim in a course in science. One thing is quite sure that subject matter alone cannot make a course in science. Our schools are crowded; and yet when we consider that only a small per cent of our high school graduates go on to college and that only a small per cent of our college graduates enter the various fields of science, it is evident that there is more to a science course than subject matter. The spirit of science and the method of science (the so-called scientific method) are just as important as the subject matter. If our courses in science help our students to acquire the spirit and the method of science, or a scientific turn of mind, then their value can never be questioned.

Occasionally, a person is referred to as having a "judicial turn of mind." I have heard this said of Chief Justice Taft. Some men are referred to as having a "practical turn of mind." This is often said of such men as Edison, Bell and Marconi in distinguishing their work from that done by workers in pure science who are interested chiefly in enlarging the field of knowledge.

Having used the term "the scientific turn of mind," let us see what is meant by this expression. (Let me say that it is not my purpose to attempt to analyze the mind of the scientist. The paper will deal rather with the *aims* of the scientist and his *method*.) A study of the history of science shows that men like Gilbert, Galileo and Vesalius stand out distinctly from the men of their times. Why? Is it because they were pioneers in their fields?

But why were they pioneers? First they were imbued with a love for truth. Second, they were open-minded; or to use Twiss's language, "They kept their concepts, generalizations and classifications in a semifluid state, being ready at all times to enlarge or revise them when necessary." Though bigotry and prejudice were rampant in the time in which they lived, they were able to live above these. Third, they refused to be fettered by tradition. To them it was more profitable to enlarge the bounds of knowledge than to be a slave to medievalism. Fourth, they preferred to adhere to observation and experiment rather than to the authority of men who lived a thousand years earlier; and in spite of an unsympathetic and benighted

populace, in spite of the terrors of the Inquisition, in spite of the opposition of the church and priesthood, they possessed the courage to test and set aside well-established medieval truths when they were found to be at variance with observations and experiments carefully carried out.

The men were the founders of the scientific method, which today is not limited to the sciences; but has been carried over into many other fields of inquiry. In using this method to arrive at truth, information is gathered by accurate and unbiased observations from sources far and wide, this information is arranged according to some scheme of classification, and from these classified facts general statements (principles) are derived.

To me, the easiest way to get an idea of the meaning of the phrase, "the scientific turn of mind," is to take up some of the traits possessed by these men and examine them in detail. I make no pretense to exhaust the list nor to name them in order of importance.

One of the most important traits of a mind scientifically inclined is *love of truth.* "Intellectual integrity" and "uncompromising honesty" must characterize the mind of one imbued with the true spirit of science. May I say parenthetically that if some of the advertisers in our radio magazines were more imbued with a love for truth, they would save some of the radio amateurs many a heartache.

If the experimenter is interested in pure science, it is his object to discover new truths. If he is interested in applied science, it is his object to make practical applications of the truths already discovered. The very fact that he gives his time to science should indicate that he is interested in searching out truth; and hence his mind is imbued with a love for truth. To be inclined otherwise is to defeat the very purpose for which he works. Lord Kelvin, one of the greatest of the nineteenth century physicists, maintains that "investigation in the laboratory should leave no room for shady, doubtful distinctions between truth, half truth, whole falsehood."

Randall, in his book, "The Philosophy of Power," speaks of the "instinctive hunger for truth." He says very plainly that our education, no matter how extended, is a failure unless it has made us feel the supreme value of truth, and has awakened in us a profound love for truth.

"It is absolutely necessary to be mentally honest with ourselves. We must learn to investigate fully, to weigh evidence carefully and to decide imparitally. Prejudice and bias, the

enemies of intellectual integrity and mental honesty, must be kept under foot."

Himes, in speaking of the characteristics of an engineer, stresses the love of truth when he says: "Honesty is a characteristic of engineers. It is a result of their training. Their habit of thought must be honest for success in their work. The force of gravity is never asleep. It must be reckoned with. It is the same with the expansive force of steam—they are always the same. For the engineer who would cheat such forces the penalty is death."

Rightly has Gregory in his excellent book, "The Spirit of Science," to which I am greatly indebted, said: "The love of truth is the beginning and the end of wisdom."

During the past years various speakers and writers in referring to the prevention of future wars have used these words frequently, "Diplomacy has failed." What is diplomacy? A dictionary at hand defines it as "Dexterity in managing negotiations of any kind; artful management with a view to securing advantage; political skill." From this definition is it not understood that a diplomat will take advantage of the situation if an opportunity is afforded? Does a diplomat ever stress the proverb "Truth is mighty and will prevail."

In a former issue of Life, the cartoonist has portrayed the relation of diplomacy and truth. Truth is standing in one corner of the room saying: "They won't have anything to do with me." Rather a true picture, isn't it?

I am not very familiar with politics; but I am told that the ward politician not only tries to cover up the mistakes of his own party; but he also wilfully misrepresents the opposite party. Neither am I familiar with legal proceedings; but isn't it commonly understood that the average lawyer will conceal truth in behalf of his client? The attitude of the scientific investigator must be quite different from these. His object is to seek out truth and to defend it at all times.

Lest I be misunderstood in making these comparisons, let me say that the scientific turn of mind is in no wise limited to those who study and teach the sciences. It should be characteristic of all seekers after truth, no matter what the field. Again, unfortunately, it does not always follow that one who shows the utmost love of truth in the laboratory will do the same in the street. It is for educational psychologists to tell us how much the training gained in one field can be carried over into another. Until this is known with more certainty, it is not safe to conclude

that because one is possessed with the love of truth while engaged in scientific investigation that he will be while buying or selling real estate. But, if there is such a thing as "getting the habit," then the attitude of the science student in the laboratory should do more to make him truthful in a real estate deal than the attitude of the diplomat or politician who often wilfully conceals or abuses truth.

Twiss in "Science Teaching" has well said: "Scientific study, if carried on in the true scientific spirit, compels sincerity, out and out intellectual integrity, uncompromising honesty, at every step. 'What are the actual facts?' 'What is the truth about them?' These are the sole ultimate questions of scientific study. To know the truth and to put it into usable form is the only aim. Since honesty is the very essence of scientific study, the student of science under good scientific instruction is trained day by day to habits of honesty, to habits of seeking the truth, and he may therefore come to realize the general value in individual and social life of sincerity, honesty and love for knowledge of reality for its own sake." The poet Keats may deplore the fact that science takes out charm or mystery; but let us not forget that it puts truth in place of these; and yet, living as we do in this scientific age, few have the scientific spirit, for we buy patent medicines because of testimonials which should read "Cured in spite of it." Likewise, we buy our face powders because they are named for some screen beauty.

A second characteristic of the scientific mind is openmindedness. In his pamphlet, "How to Study," Swain says: "Study with an open mind and with no preconceived ideas—be ready to accept gladly any logical conclusion from the facts, even if unpalatable." This is splendid advice for students entering the science laboratory; for in scientific investigation, preconceived notions, if they exist, must be kept in the background. What the investigator expects to find—and vision is necessary—must in no wise be permitted to interfere with what he does find. Hypotheses, no difference how cherished, must be modified or even abandoned when they are not in accord with observation. Much as we cherish Newton, if Einstein's theory proves to be more general and comprehensive—experiments made indicate that it is—then we must accept Einstein. Here, as elsewhere, prejudice must be dismissed and judgment held in suspension until the investigation has been completed.

One of the most serious drawbacks in government by political

parties is party prejudice. At a recent educational meeting, the dean of education in one of our state universities gave a good example of party prejudice. The Democrats being in power worked for a new and much-needed state constitution; but the Republicans were strong enough to block the measure, and did so because it was initiated by the Democrats. Two years later the Republicans came into power and realizing the need of a new state constitution took measures to secure one. The Democrats now voted against the measure to a man. Why? To them it seemed better to kill this popular measure than to let the opposite party get the credit of putting it through. Do not get the idea that party prejudice is limited to our legislators. Many of us read the newspapers that agree with our party prejudices. The blacker these paint the opposite party the better we like it.

If you would know the part that prejudice plays in our textbooks on United States history read Millikan's Commencement Address at Stanford University, June, 1923. It is published in Science, October 19, 1923. In this address, Millikan quotes the words used by a prominent school book publisher in answer to a question regarding textbooks on United States history. "It is not yet possible—for the reason that school boards do not yet in this country want history to be taught as it happened. They want something to be called history which pleases their pride and appeals to their prejudices, and I know it because we are ourselves just having our histories attacked in the state of Washington on the ground not that they are incorrect but that they are unpatriotic. And this sort of thing is happening to publishers all over the United States." In commenting upon the publishers' statement Millikan says: "This means that we are doing in America today precisely what the whole world condemned Germany for doing in all the years preceding 1914, namely, *teaching nationalism in preference to truth.*"

Today, even in our dealing with the most critical and far-reaching post-war problem, prejudice is rampant. Let the average American start to study international affairs, say the League of Nations, and he sees at once how hard it is to get facts; first, because its advocates have too often indulged in a false idealism, and second, because its opponents through prejudice have not scrupled to misrepresent it.

In an able editorial deploring the Senate's stand on the Versailles treaty, a St. Louis paper, at that time Republican, now

independent, used the following language: "It must be said in all candor, that partisan politics and personal prejudices are mainly responsible for the rejection. As has been said repeatedly, the treaty is not a party question, nevertheless it has been made a party question and has been crushed between the stones of party antagonism."

In this paper I do not care to review the history of the struggle between science and dogmatic theology—I did not say religion. It was only natural that they would clash as their methods were so different. The theologians being of the opinion that complete truth had been revealed felt themselves called upon to prevent inquiry, and to persecute those who persisted in displaying an inquiring turn of mind. Such a view was deadly to science which courts thorough and open-minded investigation, and even rejoices when old truths are supplemented and new ones are discovered.

Another characteristic of the scientific mind is that it will not be fettered by tradition. Aristotle, unfamiliar with telescopic observation, referred to the sun's face as "immaculate"; and, as usual, his medieval followers adhered to his teachings and denied sunspots. To Galileo, one of the chief founders of the modern scientific method, it was not what Aristotle said; but what the eye backed up by the telescope saw after careful and patient observation.

Volumes might be written on the part tradition has played in our educational systems and school curricula. Today we are battling to break away from tradition in education. As the study of education becomes more and more scientific, as we continue to make advances in educational tests and measurements, we shall depart more and more from tradition.

In this enlightened twentieth century, it is surprising to know how large a part tradition plays in our everyday thought. Talk with the average person about the weather and you will be surprised at the hold tradition still has upon us, in spite of the fact that many of these traditions have not met the approval of our trained meteorologists. Much work remains to be done in sifting the wheat from the chaff. According to Sir Oliver Lodge, meteorology is in need of a Kepler and a Newton.

The belief that the winters today are not as cold as they were fifty years ago is still with us. Indeed, a cold winter today is referred to as an "old-fashioned winter." I have not the evidence at hand to pass judgment on this mooted question; and already we have had too much talk and not enough of evidence

in the case. However, I do desire to raise this question: Can this be explained, in part, at least, when we consider that it is the unusual that makes a lasting impression; that our houses are built better today, the heating systems are better and the fuel is stored in the fall; and that our transportation facilities are much better?

The weather records kept by the early New England settlers tend to explode the belief in "old-fashioned winters"; for in these records, while we find descriptions of deep snows and violent storms, we also find descriptions of mild and open winters.

The "old-fashioned Christmas" characterized by snow and ice sufficient for sleighing and skating lingers still. Gregory says that after a careful examination of old diaries and observations made at Greenwich, Moore made the statement before the British Association for the Advancement of Science in 1908 that the climate of the British Isles had not changed appreciably during the past six hundred years.

It is hard to find anything more unscientific than our modern long-range weather forecasts, which are scattered broadcast in our patent medicine advertisements. Much as we desire long range forecasts, scientific meteorologists tell us frankly that they can not furnish them. Sometimes general predictions are made for a week ahead; but the bulk of the predictions are for twenty-four to thirty-six hours ahead.

It is true that astronomers can foretell eclipses with a high degree of precision; but the weather is made up of so many variable elements that long range forecasts at present are considered worthless. Long range predictions are commonly based on the supposed influence of the moon and planets, the action of animals and plants, or the popular belief that if one season is hot and dry the following one will be cool and wet.

A study of the history of medicine shows that adherence to traditions has been a stumbling block to progress. The advances in medicine during the past hundred years are due to the fact that the scientific method of procedure was inaugurated in this field. As a result medicine has been placed upon an experimental and scientific basis; and while there is still much investigation to be done, men like Pasteur, Koch, Ehrlich and others, by untiring research, have blazed the trail. The thing needed now is to continue the investigations in this field.

Another characteristic of the scientific mind is that it is not a slave to authority. Swain in his pamphlet, "How to Study,"

tells us to be "modest intellectually," and yet at the same time to be "self-reliant." This was Galileo's attitude. Prior to the time of Galileo, most of the study in science consisted in memorizing Aristotle, Galen and other men who were regarded as authorities. Galileo started by reading Aristotle; but his inquiring mind soon led him to question Aristotle's conclusions, in spite of the reverence with which Aristotle was held. Knowledge of falling bodies obtained by observations at the leaning tower of Pisa were more satisfying to him than to swallow Aristotle wholesale.

The Belgian anatomist, Vesalius, is the Galileo of biological science. Locy in his "Biology and its Makers," characterizes him thus: "He (Vesalius) tried to do what others had done before him—he tried to believe Galen rather than his own eyes, but his eyes were too strong for him; and in the end, he cast Galen and his writings to the winds, and taught only what he himself had seen and what he could make his students see, too. Thus he brought into anatomy the new spirit of the time (the scientific spirit)."

The printed page was not sufficient for Galileo and Vesalius, especially when it contained unverified material handed down from generation to generation. They preferred to see with their own eyes and to acquire truth by their own experiments. They accepted the dictum of the Apostle Paul: "Prove all things and hold fast to that which is good."

Students of physics are familiar with the celebrated controversy regarding the nature of light, in which the authority of Newton cast a shadow over the wave-theory of Huygens until the work of Young and Fresnel on interference and polarization restored the wave theory to its proper place. Stokes, who held Newton's chair in Cambridge for fifty years, deplored the fact that the authority of Newton kept back the wave theory of light for nearly one hundred fifty years. He sounds a warning against authority, even though that authority be Newton.

The baneful influence of men of authority, especially when they get out of their own fields, is seen in the history of aviation. Le Conte, the famous geologist, doubtless retarded work on mechanical flight by advocating that no machine could exceed the size of the largest birds. The largest bird is a pigmy compared with a modern airplane.

Hiram Maxim's name, because of his work on machine guns, carried weight; and he was willing to use the weight of his author-

ity against aviation thus: "Nature has not yet developed a bird that can fly on petroleum."

Newcomb, the great American mathematician, did not spend his time like some mathematicians trying to prove mathematically the impossibility of flight; but in referring to mechanical flight he did make the statement that he felt the impossibility of flight as completely demonstrated as any physical fact could be. Suppose that Langley and Wrights had taken the same stand.

With the United States as a mere infant, Washington, as usual, used sound judgment in regard to European alliances; but, I dare say, he would not wish this statement used as an authority (as is often done by our Senators) in our international relations today, since 125 years have brought about sweeping changes.

I have not space to take up the development of the laboratory in science and show how it has tended to set aside authority and to make the student an investigator. Such men as Liebig in Germany, Kelvin in Scotland, and Pickering in America realized the importance of the laboratory in science instruction. In 1879 Cambridge University opened the Cavendish Laboratory which has been made famous the world over by its directors, Maxwell, Rayleigh, J. J. Thomson and Rutherford. The founding of university laboratories did not meet the approval of some of the men in the other departments of the universities. Todhunter, well-known as a teacher of mathematics, in speaking against laboratories, showed that he was a strong advocate for taking things on authority.

His argument against laboratory work is as follows: "If he (the student) does not believe the statement of his teacher—probably a clergyman of mature knowledge, recognized ability and blameless character—his suspicion is irrational and manifests a want of power of appreciating evidence."

I firmly believe that if Todhunter had lived to see how J. J. Thomson and some of his associates, as Rutherford, C. T. R. Wilson and others, have enlarged our knowledge of the nature of electricity and matter—a thing that could not have been accomplished without the laboratory—he would certainly have withdrawn his objection.

The study of science has extirpated the anger of Jove and other gods, evil spirits and demons; and, if we as teachers can succeed in imparting to our students the scientific habit of mind, and in having them carry it over into their daily lives, bigotry

and prejudice will eventually have to go, and intellectual integrity, open-mindedness and love of truth will take their place.

It is not enough to cultivate the scientific attitude of mind for laboratory use alone; but it must be cultivated to such an extent that it can be carried over into everyday life.

In our high school and general college courses in science, it is not sufficient to have the students master the subject matter. It is equally essential to know the method of science, and to acquire a scientific turn of mind which will be extremely useful no difference what fields our students enter after leaving school.

THE CURRICULUM IN GENERAL SCIENCE.

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Science instruction in the first year of the senior high school has presented a serious problem. The history of the many attempts to fit the special sciences into the ninth grade is well-known. As a result of these experiences, the conviction has arisen that no one science is adequate for the introductory course in science in the secondary school. Many textbooks have been developed, all based upon the conviction that the first year of science in the secondary school should be fundamental to all the sciences.

Recently the writer undertook a careful study of two such textbooks. The primary purpose in this investigation was to discover the facts included in each textbook, the curriculum. While the investigation is not of sufficient scope to warrant general conclusions, the method may be of value to teachers of general science who are interested in curriculum construction, and to supervisors concerned with the training of teachers in service and with the selection of textbooks in general science. An effort will be made to present the limited data in such a way as to make clear the facts obtained.

The first of the textbooks[1] states that "the object of the course is to develop a usable fund of knowledge about the common things and helpful and trustworthy habits of considering common experiences in the field of science. It is expected that pupils' interests and abilities will be discovered and utilized in such ways that more effective and more profitable work may be done in the vocations or in later studies." No attempt is made in

[1]Caldwell, O. W. and Eikenberry, W. L., General Science, Revised Edition. Boston, Mass.: Ginn and Company, 1918. Preface, P. iii.

this text to preserve the unity of any one of the different sciences; unity is secured by the logical interrelations between the topics which compose the course. These topics are readily grouped under six major divisions: (1) the air; (2) water and its uses; (3) work, energy, and electricity; (4) the earth in relation to other astronomical bodies; and (6) the life upon the earth. The course presented in this textbook is, the authors tell us, the result of ten years of experimentation in secondary schools.

The second of the textbooks to be used in this study[2] has for its purpose not so much the development of the subject alone as the development of the pupil. "The scientific information will enable him to appreciate better the natural phenomena going on around him. The scientific training should enable him to observe more accurately, to interpret more sanely, to understand the vital importance of everyday affairs, and to train him to apply acquired knowledge to useful ends."

The authors of this book present it stating that "it meets these fundamental requirements; first, in providing a ground work in physics, chemistry, botany, zoology, physiology, and physical geography; and, second, that it has stood the test of time." The course as presented represents the results of fifteen years of classroom instruction in general science. Subject unity is preserved throughout the textbook.

The method of the study is one of analysis to discover the material common to both textbooks and then to present this material in the form of statistical tables. As in any analysis of textbooks, it is necessary to assume that the authors are qualified to express expert opinion. Of course, the opinion of experts does not always agree on all points.

The unit used for measuring the amount of material relative to each topic for this study was the square inch. This work was done carefully. In some cases where several illustrations appeared, it was necessary to make a number of computations. Printers' estimating tables were used in obtaining the number of words a square inch for each of the several sizes of type used in each text. The amount of space given to diagrams, pictures, statistical tables and other illustrative material was recorded separately from the amount of space devoted to print on each topic.

It should not be understood that emphasis as shown by the

[2] Weckel, A. L. and Thalman, J. L., A Year in Science. Chicago Ill.: Row, Peterson and Company, 1916. Preface, P. v-vi.

amount of space devoted to the different topics gives the approximate relative importance of the several topics. The method has both values and limitations. It permits of a careful analysis of the material presented, and of a collection of all the information from the sources examined, but it introduces certain errors, those due to the necessary reliance upon expert opinion and certain variable errors through the use of tables for obtaining the word count.

An actual comparison between the estimated word count for six pages of each textbook examined and the actual number of words on each of the pages showed that the variation is comparatively small, and that the error may be either positive or negative. Errors due to sampling may be found in the study only in connection with the comparison noted in the above paragraph. In general, the method was used as the best available which was suited to the conditions connected with the study.

	Caldwell & Eikenberry			Weckel & Thalman		
	No. of Words	Sq. In. of Illustrations	Quantitative Rank	Number of Words	Sq. In. of Illustrations	Quantitative Rank
Astronomy	10,826	128.37	5	0	0	0(8)
Botany	12,946	187.99	4	7,588	257.83	5
Chemistry	3,636	25.95	7	11,311	152.82	3
Physical Geography	17,521	346.02	2	12,021	230.25	2
Physics	35,113	567.69	1	9,650	132.39	4
Physiology	7,903	72.86	6	25,097	215.36	1
Zoology	2,630	16.19	8	7,539	437.29	6
Miscellaneous	16,478	287.83	3	2,669	32.18	7

It was necessary to determine arbitrarily the placement of certain subject material for the statistical study. For instance, there was some question as to the placement of certain paragraphs treating with matter. The writer carefully read passages on the subject in several physics and chemistry textbooks, grouping the subject material with that to which it was most closely related in treatment, physics.

Since it is impossible to present in detail the tables of crude data which represent the most of the statistical study, a summary table is given above.

The preceding table shows rather inadequately the wide differences in the subject matter of the text books examined. Since it is impossible in this short report to go into detail in the matter, physical geography, the one subject concerning which agreement in quantitative ranking in the two textbooks was found, was chosen for a more detailed discussion.

Both textbooks unite in the presentation of facts concerned with weather and climate, winds and storms, the surface of the earth, erosion by water and air, and soil water and drainage. Caldwell and Eikenberry also discuss the seasons, day and night, and the climatic influences of large bodies of water. In general, agreement was high when the treatment of the subject is compared with that for other subject material found in the two textbooks.

Certain limitations in a study of this nature, those due to the method of procedure followed, have already been pointed out. The conflict of opinion as to what is worth while for inclusion in a textbook for general science classes presents another serious limitation. In but three of the eight topics treated is there anything like close agreement.

Authentic information as to the frequency of use of textbooks examined in a study such as the one reported here, norms of standard tests and scales for use in teaching general science,and a careful analysis of a number of additional textbooks would yield a more satisfactory basis for curriculum revision in general science. Certainly much remains to be done in the field.

INCREASE WOOD PULP RESOURCES BY NEW PROCESS.

The wood pulp resources of the world may be greatly increased by the use of a new process of manufacture described by Prof. Ralph H. McKee, of Columbia University. There are several species of coniferous woods, said Dr. McKee, which are at present unsuited for manufacture into sulphite pulp because of their high content of resinous matter. The process which he described consists in dissolving out the turpentine and resin with liquid sulphur dioxide and then converting the residue into the usual sulphite pulp which is stated to be of good quality. It was also stated that turpentine and resin could be produced commercially by this process cheaper than by present methods.

Dr. McKee also described a new process for eliminating the nuisance of waste sulphite liquors from pulp mills. This process, which he said has been successful and profitable on a commercial scale, depends upon the fermentation of the liquor. Commercial alcohol is obtianed and the residue evaporated and used as fuel. Dr. McKee stated that the fuel so obtained from the average pulp mill is adequate to give a thousand horsepower day and night besides sufficient steam to do all the evaporation required.—[*Science Service.*

A PRACTICE STUDY IN PARAGRAPH SUMMARIZING IN CHEMISTRY.[1]

By Kimber M. Persing,
Glenville High School, Cleveland, Ohio.

The following study was made in an attempt to measure the influence, upon the learner, of giving definite instruction and drill in paragraph summarizing in chemistry.

Four classes of chemistry students were selected for the study. Three of the sections were just beginning the study of chemistry, while the other "Group B" was completing the second semester of chemistry[2]. Groups "A" and "B" were selected as control groups while groups "C" and "D" were the experimental groups. This grouping was made because it seemed to represent the most equal distribution of the students. Intelligence scores were not available.

Procedure: An initial test was given to all sections before beginning the experimental work. The test consisted of four paragraphs and is given below. These paragraphs will be referred to as Tests 1, 2, 3 and 4. When the tests were given each student was provided with a printed copy containing directions for work. No other instructions were given.

The Tests.

Name..... Grade.....
Section..... Date.....

Directions: Read through the following paragraphs. Then reread the first paragraph and summarize it in a sentence of about ten or twelve words. Write your answer in space provided. Continue with paragraphs 2, 3 and 4 in the same manner.

Paragraph No. 1. Yarn and cloth made from cotton and linen are not pure white. Bleaching is therefore an important process in the manufacture of pure white goods. The fibres are first freed from wax by boiling in a solution of caustic soda, and washing with water. The goods are then saturated with a solution of bleaching powder and piled loosely until the coloring matter has been oxidized. The cloth is washed thoroughly with water when bleaching is completed.

Write your answer here:.....

.....

Paragraph No. 2. The growing plant requires a great variety of food material. From this material, with the aid of the sunlight, the plant manufacturers its own food as well as many important products. The plant receives its carbon as carbon dioxide from the air through the stomata of the leaves. The water, which supplied the hydrogen, is absorbed through the roots. The nitrogen, sulfur, iron, and various minerals are likewise absorbed through the root system. This plant food is absorbed as a solution from the soil by the tiny root hairs of the extensive root system. The plant food to be absorbed must be in solution.

Write your answer here:.....

.....

[1]Read November 9, 1923, at the Meeting of the Cleveland Educational Research Club

[2]Chemistry is an elective during the Senior year.

Paragraph No. 3. [2]A child is helpless on the first day of his life and needs much care for several years. When one day old, he would starve to death if some one did not look after him. He cannot hold up his head; he cannot creep; he cannot sit up or roll over. Of course he cannot walk. He must stay where he is put. He cannot hear. He can hardly see and cannot talk or even babble. He is about one year old before he begins to talk or walk. Several years more will have passed before he can move about as freely and talk as freely as grown ups do. Even after he enters school, he needs his parents' aid. The average child of ten would die for want of food and clothes and shelter if some older person did not help him. It takes a child a long while to grow old enough to care for himself.

Write your answer here:.....

.....

Paragraph No. 4. [2]While the infant is very helpless during his first year and must have help from grownups for several years, many of the lower animals are almost full grown before they are two years old. They can walk on their first day; some of them can even run. A colt is strong enough when six hours old to bear upon his back a baby of six months or more. This colt needs no help and seems hardly to feel the child's weight; but the baby could not sit alone even if the colt were still. Some one would have to hold the baby on the colt. That little horse can go about the fields getting his own food. The child still helpless must be fed and cared for by his mother. Before the horse is four years old he takes his place beside an older horse in drawing heavy loads. The child at that age is not ready for the kindergarten. Nearly all the lower animals can move about on the day they are born and all of them grow up in a short time.

Write answer here.....

.....

.....

The initial test papers were labelled and filed for scoring. None of the papers were read or scored at this time.

The experimental groups were then given instruction and drill practice in paragraph summarizing. On the other hand the control groups received no such instruction or drill work. The time required was taken out of the regular recitation period, either at the beginning or near the close in order to avoid serious interruption of the daily recitation.

The actual time spent in drill work consisted of twelve five-minute periods, extending through three weeks.

During these weeks the daily assignments were the same in all sections, with the exception of "Group B" which being an advanced section, was doing a different type of work.

The material used for drill purposes was selected from daily assignments or review portions of the text. However, during the period of the experiment no reference was made to the initial tests and the daily assignments did not involve materials found in Tests 1 and 2.

At the close of the drill work the initial tests were again given,

[2]Tests 3 and 4 were prepared by Dr. Gary C. Myers, Cleveland School of Education.

to both the control and experimental groups, as a final test. These test papers were labelled and filed for scoring with the initial test papers.

Scoring the Tests: The papers were first scored on the basis of comparison. The final answer of a given student was compared with his answer in the initial test, and scoring the final answer, either positive, (+) or negative, (−) depending upon improvement or loss in statement of the final answer.

The results of scoring by this method are given in Table No. 1. The results seemed to indicate very little change in student performance. An objection to the comparison scoring seems to be due to the fact that only papers showing a fluctuating value receive any recognition.

TABLE NO. 1: RESULTS OF SCORING BY COMPARISON.

Test	1				2				3				4			
Section	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
No. Students	17	20	23	23	17	20	23	23	17	20	23	23	17	20	23	23
No. Cases Improvement	4	5	12	7	4	5	16	13	3	7	12	10	4	8	10	12
No. Cases Loss	3	3	1	3	2	2	2	0	3	6	4	4	2	8	2	2
Actual Change	1	2	11	4	2	3	14	13	0	1	8	6	2	0	8	10

In an attempt to secure a more adequate measure of the student achievement, it seemed necessary to apply a different kind of measure in scoring the papers. For this purpose a key or scale was adopted as a measuring device and was developed in the following manner. Each answer from a given test was copied separately on a small card and these were then classified or sorted into groups. The cards were sorted by three persons working independently of each other[4]. When the results were tabulated by the writer, it was found that the cards could be conveniently sorted into four groups. From each of the four groups of sorted cards, four or five typical answers were selected. These answers, having received unanimous classification, were adopted as the key or scale. The scale was thus made up of four divisions or groups, each consisting of four or five types of answers. To each group in the scale was assigned a numerical

[4]Dr. Gary C. Myers of Cleveland School of Education, and Miss L. C. Allen of Longwood High School assisted the writer in this part of the work.

value ranging 0, 1, 2, 3. The scales for Test 1 and 3 are given on pages 600 and 601.

The papers were then scored again, by using the key, after all previous scores had been removed. Before scoring, the papers were thoroughly intermixed and so arranged that the student's name and section number were not visible to the person scoring the paper. The scale was then applied and both the initial and final answer were scored, and marked the numerical key value.

TABLE NO. 2: SCORES OF SECTIONS USING THE SCALE, AS A MEASURE.

Test	1				2				3				4			
Section	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
No. Students	17	20	23	23	17	20	23	23	17	20	23	23	17	20	23	23
No. Points Initial Test	14	13	14	23	11	14	14	15	19	19	27	21	11	23	17	22
No. Points Final Test	15	18	35	36	13	18	28	42	16	15	36	30	17	21	31	39
% Score Initial Test	27.5	22	20+	33+	21.6	23	20	22	37	32	39	30	22	38	25	32
% Score Final Test	29	30	51	52	25	30	41	61	31	25	52	44	33	35	45	57
% Change	1.5	8	31	19	3	7	21	39	–6	–7	13	14	11	–3	17	25

The results of scoring by this method are given in Table 2. The scores represent the total points earned by a given section. The percentage scores were calculated according to the formula, it being assumed that each paper had the possibility of making a perfect score.

$$\text{Formula: Percentage Score} = \frac{\text{Total Points} \times 100}{\text{No. Papers} \times 3}$$

In Table 3 the scores of the different sections were combined into "Control" and "Experimental" group scores.

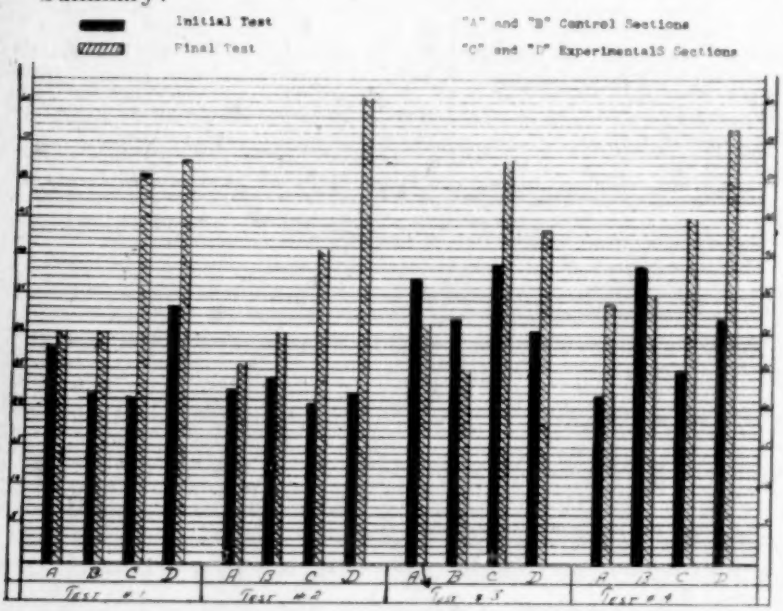
The results obtained by the scale scoring seem to yield a better measure of actual change in student performance, than by the comparison method. This is probably due to the fact that the scale recognizes a wider range of values. It will be noted by reference to Tables 2 and 3, that the initial results of the different sections are fairly uniform. On the other hand, in the final tests, there is considerable fluctuation. These values are per-

TABLE NO. 3: COMBINED SCORES OF SECTIONS INTO CONTROL AND EXPERIMENTAL GROUPS.

Test	1		2		3		4	
Group	Con.	Exp.	Con.	Exp.	Con.	Exp.	Con.	Exp.
No. Students	37	46	37	46	37	46	37	46
No. Points Initial Test	27	37	25	29	38	48	36	39
No. Points Final Test	33	71	31	70	31	66	43	66
% Score Initial Test	24+	26.8	22.5	21	34	34.8	32.4	28.2
% Score Final Test	29.7	51.5	27.9	50.7	27.9	47.8	38.7	48
% Change	5.7	24.7	5.4	29.7	-6.1	13	6.3	19.8

haps more clearly represented in the Graphs 1 and 2.

Summary:



GRAPH NO. 1. PERCENTAGE SCORES OF INDIVIDUAL SECTIONS.

a. Initial tests were given both control and experimental groups before beginning the experiment.

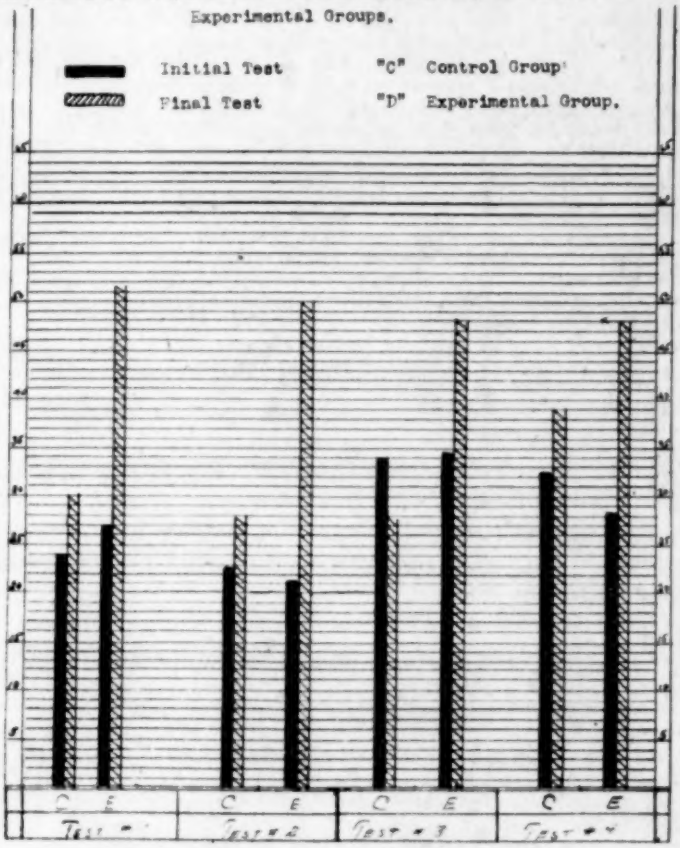
b. The experimental groups were given twelve, five-minute drill periods in summarizing, extending through three weeks.

c. At the expiration of the drill period, the initial tests were given to both control and experimental groups as a final test.

d. The papers were scored by means of a scale.

SCALE FOR SCORING TEST NO. 1.

Value 3 Points:
Cotton and linen are bleached by oxidation.
Cotton and linen are bleached by oxidizing the coloring matter.
The bleaching of cloth is due to oxidation.
Cotton and linen fibres are made white by oxidation.
Bleaching goods pure white is accomplished by oxidation.



GRAPH NO. 2. COMBINED SCORES OF SECTIONS AS CONTROL AND EXPERIMENTAL GROUPS.

Value 2 Points:
Bleaching is a process by which colored goods are made white.
Yarn and cloth are made white by bleaching.
Pure white goods can be obtained by bleaching.
Bleaching is necessary to make yarn and cloth white.
Bleaching is important in production of pure white goods.

Value 1 Point:
Bleaching is important and is a chemical process.
Yarn and cloth are bleached through a chemical process.
Chemical action plays an important part in bleaching.

Value 0 Points:
The reasons why and ways to bleach.
The things yarn and cotton have to go through to be bleached.
Bleaching is an important process in the manufacture of cloth.

Cotton fibres are bleached by using bleaching powder.

SCALE FOR SCORING TEST NO. 3.

Value 3 Points:
It takes a child a long while to care for himself.
It takes a baby many years to learn to care for itself.
A child needs much care for several years after birth.
It takes a long while for a child to grow old enough to take care of himself.

Value 2 Points:
A child is dependent upon his parents until ten years of age.
From ages of one to ten a child is helpless.
A child is helpless for several years after birth.
At an early age a child cannot care for himself.
A child needs aid from older people throughout his youth.

Value 1 Point:
Children are practically helpless so older people must help them.
Children need much care because they cannot care for themselves.
A child is helpless if he does not receive aid.
A child needs the care of his parents in proportion to his age.
A baby would die were it not for help received.

Value 0 Points:
It takes many years for human people to be self reliant.
A child and his hardships in life.
A child weak when infant later becomes strong.
This explains the lack of instinct born in children.
A child is very slow in learning the ways of older people.

e The results indicate a decided improvement on the part of the experimental sections.

Conclusions: On the basis of the results obtained it seems the following conclusions may be reached.

1. There is fairly clear evidence that training in summarizing as applied to chemistry means a very decided improvement in learning efficiency.

2. That improvement in one type of subject matter has carried over to other types as evidenced by the results in tests 3 and 4.

DIFFUSION OF GASES.

BY L. P. RAMENSTEIN,

High School, Clinton, Iowa.

Probably a variation of the method of proving diffusion of gases is superfluous. My only excuse for offering this is the fact that I believe it illustrates the principle more clearly than the demonstrations suggested in any of the dozen high school texts I have examined.

The variation suggested is the use of a wash bottle of hydrogen inverted over a bottle of air.

The aim of the experiment reduced to its simplest terms is to prove that two gases mix in spite of the fact that the less dense gas is placed on top of the more dense. The two essential points

to be proven then are (a) That the gases mix. (b) That hydrogen is less dense than air.

While the gases are given time to diffuse the nature of hydrogen can be explained.

The explosive nature of hydrogen can be demonstrated by collecting a bottle of the pure gas and noting that it burns quietly while a bottle containing a mixture of air and hydrogen explodes when ignited.

The density compared with air can be shown by collecting two bottles of the gas and allowing one to stand open with mouth upward and the second mouth downward for a short time, and then igniting contents.

While these preliminary tests are being made the gases will have had time to diffuse and the presence of hydrogen and air in both bottles can be conclusively proven by igniting the mixtures.

The advantage of this demonstration lies in the fact that the proof rests upon the production of a slight explosion which can easily be heard by all in class instead of a chemical reaction which depends upon vision and consequently may not be clear to all.

Then, too, it is free from the objection that the mixing is affected by chemical reaction which is a point of dispute in one method.

FROZEN NITROGEN CLOUD MAKES THE SKY BLUE.

The blue color of the atmosphere is caused by a stratum of frozen, crystalline nitrogen in extremely high altitudes, according to theories recently put forward by Dr. L. Vegard. The aurora borealis and zodiacal light are attributed by him to the same cause.

Dr. Vegard asserts that there is some point in the upper atmosphere where the temperature must fall as low as 350 degrees below zero Fahrenheit. If so, nitrogen, the main constituent of air, must freeze, even as snow is formed in an ordinary wintry atmosphere. The resulting nitrogen frost is likely to remain in a dispersed state. Dr. Vegard also assumes that it is electrically charged.

Inasmuch as the atmosphere is shallower near the poles than at the equator the air-frost would approach the earth more closely in polar latitudes. More light disturbances would therefore occur in such regions.

The presence of nitrogen at such great altitudes as must be necessary to get temperatures as low as 350 degrees below zero is accounted for by Dr. Vegard by the repellent effect of the electrical charges which these particles are assumed by him to carry. Temperatures at the highest levels at which observations have been made, or about twelve miles, have seldom been found lower than 85 below zero, and the temperature shows no tendency to decline further beyond that point.

Dr. Vegard suggests that this outer shell of nitrogen frost-cloud may act also as an envelope for the atmosphere and prevent it from diffusing into space.—[*Science Service.*

THE IMPORTANCE OF LABORATORY WORK AS COMPARED WITH TEXT BOOK WORK, ETC., IN THE STUDY OF CHEMISTRY.

By W. G. Bowers,

Teachers College, Greeley, Colo.

The question of the importance of laboratory work is asserting itself now more than ever before because of the following conditions: First: Industrial education, most of which is constituted of laboratory subjects, is finding a very important place in our educational system. This is growing to the extent of arousing tradesmen to organize in condemning these "school laboratory methods of making carpenters, blacksmiths, plumbers, etc." Secondly: Technical institutions, which in older educational regimes have been largely engaged in the philosophy and mathematics of fundamental theories, are devoting themselves to laboratory proofs of the applicabilities of theories that have been accepted. Also professional institutions like medical schools, are turning so much to the vivisection laboratories that there is hardly a common-wealth or a community that is not stirred up over the morality or immorality of this sort of laboratory work. Even agricultural colleges are receiving wholesale condemnation from the farmers because of the expenses incurred by their laboratory operations. It might be said in passing that there are comparatively no complaints, by either men or women, on account of the hundreds and thousands of girls learning to cook and to sew in the school laboratories.

In Teachers Colleges now, even those who hold physical sciences and industrial subjects in an insignificant position are establishing laboratories for tests and measurements, and calling the training school departments, "teaching method laboratories," or "method laboratories." It seems, however, that they are doing this only in colleges where the patrons of the training schools know less about what the term laboratory means than do the prospective student of the school, and less of the particular profession to be studied there. A third reason for so much discussion over laboratory work is the widespread laboratory idea among the high schools of the country. The supervisors of city high schools estimate that from twenty to thirty per cent of their students go from the high schools to the technical or professional schools where they must further pursue the study of their specialty in a laboratory way. So they feel that they must have a start in the high school laboratory. They feel, too, that the remaining seventy to eighty per cent of their

students who go into the trades and industries or some sort of business, will be profited more by practical laboratory work in the high school laboratory than by any sort of work in text books or library references. The supervisors of the consolidated high schools feel that they must copy the city high schools. Or, if they estimate that ninety-five per cent of their students go into some sort of work instead of going to on college, they feel all the more that laboratory work is the sort of work that will serve them better in their practical vocations than will theoretical text book work.

Any one of the four above named points might serve for lengthy consideration and discussion in itself, but we have mentioned them in this connection merely as reasons for the prominence of the question, viz. "Is laboratory work important enough in our educational system to justify the prominence which is given it, or is it important enough to give it yet more prominence as we could be able to build it up with our increasing number of practical problems to be solved and our increasing ability to secure supplies with which to do the work?" Each phase of the question has its bearing on the one phase that we want to emphasize; but the part that we are most concerned with now is the importance of laboratory work in elementary chemistry.

Probably the first question that the advocates or opponents of any such proposition will advance is what has come from it in the past? Looking at this question from the standpoint of education the opponents of laboratory work always ask the question, "In what manner did we get such masters in education, as Socrates, Pythagoras, Ostwald, Moisson, and Mendlejeff, if the laboratory is necessary to start one and keep him going in the right path? On the other side of the question the advocates of laboratory work will ask "what would ever have come out of the problems concerned with germ disease if it had not been for the laboratory work of Pasteur? What would have come out of the mysteries connected with protoplasm if not for the laboratory work of Emil Fischer? What optimism could be gotten out of our idea of the creation if not for the laboratory work of Darwin? And did not Liebig and Lavoissier contribute to education as well as to the improvements in industries by establishing laboratories for study of enormous problems?

Both of these questions, it would seem, are propounded with the idea that education is a certain force which makes an occasional mental giant or brings about some wonderful discovery

which astonishes the world. Both seem to be more or less negligent of the idea that education is something which will enable humanity to solve life's problems in a way which will bring more comfort to the soul of the race. And if even we did, on either side of the question, measure the good that the great men did, it would be unfair to measure the success of the movement as a whole, by measuring the distance between the average of the many little ones and the biggest one, or even the average of the few big ones, and calling that the measure of the success of the system. For the sake of some of the race we should take the measure of the good done to the portion of the race in which the system operates.

Rufus P. Williams, Science 18:330 (03) says "Laboratory work is too much stressed. The new methods go to the extreme. A method which discards text books and does away with recitations and which omits theory and does not give training in fundamental principles may have some excellent points, but as a whole it is abominable."

If a good authority at that stage in the development of laboratory work—when more than half of the high schools of the country were giving less time to laboratory work than to actual recitation work, regardless of outside preparation—has that condemnation; we wonder what sort of condemnation he might have for the relative stress placed on laboratory work now. This statement regarding the discarding of text books, recitations, etc., for laboratory work will doubtless always meet with approval, and the sentiment will even guide the one who is planning a course in high school chemistry.

From the time these sentiments were expressed up to the present, we have been unable to find any good authority giving expression to a desire to supplant all text book work, recitations, and library reference work with laboratory work. J. F. Sellars, Science 23; 730-36 (1906) says that in certain questionnaires sent out to certain high schools, he asked the question, "Should individual laboratory work be required?" He says that the answers were so vociferous that he would have been embarrassed to have them given in public. He says few only answered in the negative. One said he was afraid that they were making a fetish of laboratory work. Sellars himself says "We must not lose sight of the fact that chemistry, while an experimental science, possesses likewise a deductive value." Lyman C. Newell, School Review 9:286, says that the most profitable instruction in chemistry is in the experimental work.

Mann, of Chicago (Education, Dec., 1906), says "for the general student college laboratory work is neither essential nor desirable." This was about the time that laboratory work was calling for an equal share of the time given to chemistry as a study, at a time when many high schools and some colleges had no laboratory work in connection with text work, and when the average high school had less than half of the time in chemistry course given to laboratory work.

W. A. Noyes, SCHOOL SCIENCE AND MATHEMATICS, Vol. 9-748-50 (1909), in discussing the relation of laboratory work to the other phases of chemistry as a study says:

First course in chemistry should have a fourfold purpose

1. Fundamental theories and principles.
2. Facts related to theories and experiences of daily life.
3. Laboratory manipulations.
4. Knowledge of historical development.

A proper interpretation of this would give text book principal place and leave the laboratory incidental to it.

H. N. Goddard, SCHOOL SCIENCE AND MATHEMATICS 16:710, says we are liable to go too far in laboratory work. His chief argument is that the student in choosing electives avoids laboratory courses on account of time. He says also in his experience as inspector he has noticed that many students who have done excellent work in the laboratory have gained little in way of interest. A. A. Blanchard, Science 50:112- (1911), says laboratory work makes too easy memory, does not tax the mind and does not develop intellect.

It would seem from the foregoing expression from these five authorities, who ought to have known the situation, that laboratory work should have an insignificant place in instruction in any of the sciences. It is to be remembered however, that these five years in which these opinions were expressed followed the time when Dr. Elliott was responsible for giving laboratory work an impetus in the study of elementary chemistry. Whether or not we grant that Dr. Elliott was responsible for the movement, laboratory work was spreading rapidly at the time these men were expressing themselves. And at this same time it was to be expected that some conservative authorities would be afraid that the movement would go too far and that laboratory work would become a fetish. It would be only fair to assume that this was their attitude, from the fact that none of them gave expression to the opinion that laboratory work should be eliminated altogether.

During the ten years following Blanchard's statements, that laboratory work makes too easy memory and does not tax the mind, etc., most authorities were giving more or less time to analysing the results obtained from laboratory work, with the view of determining the educational value to the students. But the methods of checking up on such instructions have been so meagre and inefficient, that very little of definite value has ever been determined.

In the following paragraphs of this article we are giving some results of these analyses, as well as some observations of our own. We are leaving for a future paper the analyses and observations which have to do with educational values as they are related to the laying of a foundation for a large educational structure, or a technical education of a high order. We wish to close this discussion by dealing briefly with a few of the values that are derived from laboratory work as it helps in bringing the information necessary for the completion of a course in elementary chemistry as it is given in the high school, whose courses must meet certain standards.

Now if we determine that the information which the student of elementary chemistry wants is that which can be obtained only from laboratory work, this student has one or the other of three different methods of obtaining it: First, he can read or hear the account of the work that is done by the experimenter; Second, he can observe as the experimenter makes the investigation; Third, he can do the work himself and observe as he goes along. The question that one wants to answer now is: which of these three methods is most economical for the beginner in chemistry for obtaining the information which is essential in his course.

B S. Hopkins, SCHOOL SCIENCE AND MATHEMATICS 19:295 —says "The study of substances and their properties is the particular field of chemistry. It is the function of the chemist to investigate the action of each substance on every other substance and to study the properties of the combinations resulting from this action." He says, "From ten elementary text books statements similar to these were taken. Only one mentioned the fact that chemistry deals with laws and theories as well as certain manufacturing interests."

If this is the kind of chemistry that must be given in elementary courses, it might be supposed, with regard to some of the simplest elements their physical properties and few chemical reactions, that laboratory work is very important as a means of conveying information of that kind. The mere handling of

the elements which can be kept in the laboratory, such as the metals and semimetals, is a great aid in obtaining knowledge of their properties. Whether they are effected by air or not is seen at once. How they act with acids and alkalies is found easily and in as short time, almost as is needed to look up the information in a text book or library reference. And the preparation and examination of the main elementary gases and non metals, the observation of their properties and how they act in contact with each other, would be perhaps an economical method of gaining the information necessary to the student of elementary chemistry. But even though ten authors of text books do seem to propose this sort of chemistry to one who opposes it, the question still remains, is this the best kind of chemistry to teach a beginner? They still have the question in mind for the reason that most of these same authors, who start out on this basis, weave into their text book materials the fundamental theories, laws and principles underlying the science. We might suspect that they have in mind what one of them gave expression to on one occasion, "It is easier to fool the uneducated people than it is to fight them."

E. R. Downing, School Rev. 25:646—(17) says, "If information is the chief end in laboratory instruction the laboratory manual may be sufficient to state the facts and principles, and the laboratory assistant with its aid may direct the process of their verification. But t is to be noted that the laboratory method of acquiring information is very wasteful of time. It should be used only when the concept involved is new and needs more clarifying by contact with materials. Most information if students need it is most economically acquired from books."

We are not compelled to conclude from either the view of Hopkins or Downing that laboratory instructions are very important in teaching elementary chemistry.

Almost all that has been said so far in favor or against laboratory work has been based on general psychological principles. To make a comparison of results, now, on students who have finished a course in elementary chemistry without having laboratory work with those on students having the same course with laboratory work is an impossibility. But in the State Teachers College a condition has prevailed for the past five years, which offers an opportunity for getting an estimate on the value of laboratory work as a means of conveying information to the student of elementary chemistry.

The condition is this: Students are allowed to take the text book work for two recitation periods per week, with the privilege

of taking laboratory work for one double period per week, and receiving three credit hours for one quarter's work in the course. Or students are allowed to take the text book work for two recitation periods per week, with the privilege of taking laboratory work for two double periods per week, and receiving four credit hours for one quarter's work in the course. Two general examinations, on the work covered by the text and the laboratory exercises, were given each quarter. In selecting the examination questions, no regard was had for those students who had had only two hours of laboratory work. Since there was nothing treated of in the laboratory that was not treated of in the text, we thought there was no unfairness toward those who had had only two periods of laboratory work. It occurred to us that science teachers might be interested in the comparison of the grades made by these two classes of students.

The following table shows the average grades made in the semi-quarterly examinations by the two hour workers and the four hour workers, for the ten past quarters. In the table, given number of grades each, means the greatest number of grades found on the record for one class, and the first equal number to that found for the other class.

Quarter	No. grds. each	Two Hr. workers' grades	Four Hr. workers' grades
Winter, 1920	18	80	82
Spring "	10	76	84
Fall "	20	83.5	85.5
Winter, 1921	24	75	83
Spring "	25	81	87.9
Fall "	15	82	86.5
Winter, 1922	16	83.2	86.1
Spring "	24	87.4	87.5
Fall "	22	82.6	87.5
Winter, 1923	18	81.4	87.2

In the above table we see that the two hour workers averaged 81.2 per cent and the four hour workers averaged 85.7 per cent. This gives a difference of 4.5 per cent in favor of the four hour workers. Since the four hour workers spent twice as much time in the laboratory and one-third more time on the subject as a whole, it might seem as though the last twenty-five per cent of the time was unprofitably spent. If information lasting long enough to enable the student to pass an examination at the end of the course is the thing to consider, the last quarter of the time was unprofitably spent. But there is one or two questions which might arise, "Could the student raise his grade 4.5 per cent by spending that extra hour studying his text, and would it pay him if he could?" If information on the subject is all that is

desired, we believe it would not pay the student to spend this extra time on the one subject. So much extra time might well be spent on a new subject.

There may be classes and there may be schools in which information seeking should be the main object. If so we should be inclined to conclude that the minimum laboratory work, confined to the simpler exercises, with the minimum credit, should be given. But we realize at the same time that there are educators who would under any circumstances recommend the extra hours work for the extra four and one-half per cent on the grade for the sake of the conviction that a little work done well is better than a great amount of work done not so well.

But since the obtaining of a fund of information is an insignificant factor in the laying of a foundation for a scientific education, and many of the observations on laboratory work indicate that it plays a much greater part in many phases of education than merely the bringing of information, we expect in a later article to give some of the effects of these observations.

TEETH OF ALASKAN NATIVES RECEIVE ATTENTION.

In its work in Alaska the Bureau of Education has hitherto been unable to give systematic attention to the dental needs of the natives. By means of its ship "Boxer," the bureau is now affording such relief. That vessel is now cruising in southeastern Alaska, and among the passengers is a dentist (employed by the bureau), whose services are greatly in demand.

DENVER'S OPPORTUNITY SCHOOL WELL ATTENDED.

More than 9,000 persons attended the public "Opportunity School" of Denver, Colo. This school is open from 8:30 a. m. to 9:15 p. m., and students may attend at any time during those hours. There are no entrance requirements and no age limitations. The industrial classes are taught by practical people from the trades. The instruction includes citizenship classes; instruction in automobile mechanics; tractor work on the farm; radiotelegraphy; mechanical drafting; domestic arts and sciences; commercial branches; classes for adult illiterates; special course for messenger boys whereby they may attend the school in the time they are not engaged in messenger service; and special classes for boys mechanically inclined who do not fit into regular school work.

HIGHER STANDARDS FOR OREGON INSTITUTIONS.

New standards prescribed by the United States Bureau of Education for the higher institutions of Oregon will go into effect in 1926. The date was postponed at the request of the state superintendent of public instruction and representatives of the colleges and universities of the state. The new standards are substantially those adopted by the American Council of Education about two years ago. Oregon is the only state in the union in which the Bureau of Education is authorized by law to accredit colleges and universities. The following institutions at present constitute the list of standard institutions in that state: University of Oregon, Oregon Agricultural College, Reed College, Willamette University, Pacific University, and Linfield College.

CHECKING THE RESULTS OF CLASSIFICATION IN NINE FIRST YEAR ALGEBRA CLASSES BY MEANS OF THE HOTZ ALGEBRA SCALES.[1]

EDWIN W. SCHREIBER,

Proviso Township High School, Maywood, Illinois.

For several years the Department of Mathematics of the Proviso Township High School has been classifying, as far as practicable, the pupils in beginning algebra into three groups, (1) a −mental group, (2) a medium mental group, and (3) a +mental group. The means of such classification are primarily the scores made on the Otis Intelligence Test given the first week of school. At the end of the first semester there are of course some adjustments necessary, those failing are naturally eliminated, and others who are found by the respective teachers to be in the wrong sections are reclassified.

The Hotz Algebra Scales were used two weeks before the close of school (last of May, 1922) as a *check* on classification and it is the purpose of this paper to discuss in some detail the results obtained from the Hotz Scales.

But three parts of the Hotz Algebra Scales wer used, namely: (A) −Equations and Formula, (B) −Graphs, and (C) −Problems. Nine classes were tested: two+, three medium, two−, and two mixed or unclassified. Five teachers (Miss H, Miss W, Mr. P, Mr. F, and Mr. M) gave the tests to their respective classes and scored their own papers. It was impracticable for one person to give all the tests as in some cases three classes were reciting the same period and thus too much time would have been consumed by a single administrator. As it was it took three class periods from each section to give the tests; more time allowed would have been unjustifiable. The writer, however, took the precaution to give each teacher detailed instruction both in giving the tests and in scoring the papers. He was at all times in touch with the progress of the testing and designed the data sheets for returning the scores made by the 215 pupils involved in the study.

Let us now turn our attention to some general analysis of Tables 1, 2, and 3; later we shall discuss the more detailed analysis of the diagrams 1 to 10.

Table 1 gives the distribution of rights for all nine classes in (A) −Equations and Formula. The table should be read thus: in Mr. P's 3rd period class, a +mental group, 1 pupil got 6

[1] A Paper presented before the Chicago Mathematics Club, January 19, 1923.

TABLE 1. Distribution of "Rights" for 9 Classes is in (A)—Equations and Formula of Hotz Algebra Scales.

No. of "Rights"	1	2	3	4	5	6	7	8	9	10	11	12	Total
Teacher $+P_3$						1	3	6	2	5	4	3	24
$-H_3$			1	2	2	7	6	5	1	2			26
$-H_5$				1	4	3	7	1	1	4	1		22
$+F_2$			1	1	2	3	4	7	2	4			24
$-F_5$				2	9	4	3	1	2	2			23
M_5		1			2	4	5	4	1	3			20
$-W_2$			2	0	0	3	3	6	0	3	4	2	23
$-W_3$	1	1		1	3	5	2	2	1	2	1	4	23
W_4				2	2	1	5	4	7	4	5		30
Total	1	2	4	9	24	31	38	36	17	29	15	9	215
%	.43	.93	1.86	4.18	11.15	14.41	17.68	16.74	7.91	13.49	6.97	4.18	99.97

NOTE: The double heavy line indicates Hotz median (7.8 Rights); the single heavy lines indicate class medians.

problems right, 3 pupils got 7 right, 6 pupils got 8 right, etc; total 24, median 10, Hotz standard 7.8 It is plainly evident that the class is distinctly above the standard, in fact there are but 4 pupils below the standard. The other +mental group, $+F_2$, is not such a clear cut case of superior ability and yet more than half the class is above standard. It is probable that the two pupils receiving scores of 3 and 4 would have pursued the course to greater profit in a medium group.

In $-F_5$, a $-$mental group, we find the "tables turned" as only 5 pupils out of 23 are above standard. The class median is low and there seems to be no question that the group is properly classified. The other $-$mental group, $-H_3$, also gives evidence of low ability, though not to such a degree as $-F_5$. There is no doubt in the mind of the writer, however, that the majority of the pupils constituting these $-$mental groups would have made a poorer showing on these tests if they had received their nstruction in any other group or in an ordinary unclassified section.

The three medium groups are: mH_5, mW_2, and mW_3. Two are a trifle below standard and one above. The best example of medium ability in this test is mH_5 as it lacks the extreme cases found in mW_2.

TABLE 2. Distribution of "Rights" for 9 Classes in (B)—Graphs, Hotz Algebra Scales.

No. of "Rights"	1	2	3	4	5	6	7	8	Total
Teacher + B_3				1	5	7	10	1	24
$-H_3$		2	3	2	8	5	2		22
mH_5		2		5		7	5	2	21
$+F_2$			1	2	3	10	6	1	23
$-F_5$			1	2	7	9	3		22
M_5			1	1	8	6	2	2	20
mW_2			2	2	2	7	7	3	23
mW_3			2	8	5	3	3	2	23
W_4		1	1	8	3	2	4	8	27
Total		5	11	31	41	56	42	19	205
%		2.44	5.37	15.12	20.00	27.34	20.48	9.27	100.02

NOTE: The double heavy line is Hotz median (5.6 "Rights"); the single heavy lines are class medians.

The two mixed or unclassified groups show that M_5 is a little below standard and W_4 somewhat above. It appears that one pupil in M_5 is clearly outclassed by the other members of the section and the writer would have changed this pupil to another section had it been administratively possible The good showing made in W_4 is probably accounted for in that it contained several upper classmen.

The total column reveals the fact that taken as a whole the

work in equations and formula has been satisfactorily presented as the standard is slightly above that given by Hotz.

In Table 2 we have the distribution of rights for the nine classes in graphs. The Hotz standard n graphic work is 5.6 rights as indicated by the double heavy line. All but two of the classes are above standard. That $-F_5$ is above standard may

TABLE 3. Distribution of "Rights" for 9 Classes in (C)—Problems, Hotz Algebra Scales.

No. of Rights	1	2	3	4	5	6	7	8	9	10	Total
Teacher $+P_3$					4	9	2	6	3	2	26
$-H_3$	1	7	2	7	5	2	2				26
mH_5		1	3	5	6	4	1	1			21
$+F_2$				1	9	2	8	1	1		22
$-F_5$				3	11	3	2	1			20
M_5			2	4	8	4	2		1		21
mW_2		2	1	1	4	3	1	2	8	2	24
mW_3			2	4	1	2	4	5	2	3	23
W_4		2	2	4	4	4	1	2	5	3	27
Total	1	12	12	29	52	33	23	18	20	10	210
%	.48	5.72	5.72	13.81	24.78	15.71	10.95	8.57	9.52	4.76	100.02

NOTE: The double heavy line is Hotz median (5.6 "Rights"); the single heavy lines are class medians.

partially be explained by the fact that a new cross section blackboard had just been installed in the room where it recited. The majority of class $-H_3$ show an inferior ability, running true to form, while mW_3 makes the poorest record and must have contained some pretty slow workers.

The total result indicates that the work in graphs is well above standard. The fact that nearly 10 percent of the entire number tested completed the test with a perfect score leads one to believe that either the test is too short or too easy.

Table 3 gives the distribution of rights for the nine classes in problems. Here again $+P_2$ is seen to be a superior group as only four pupils are slightly below standard. In $+F_2$ the evidence is not so marked and yet is noticeable. The big surprise is in the two medium groups, mW_2 and mW_3, which lead all other classes. It will be noticed, however, that the range of ability in these two classes is great, showing that while some were able to do the problems in a very satisfactory manner others were almost hopelessly lost. $-H_3$ runs true to form for a $-$mental group, $-F_3$ making a little better showing. M_3 appears to be a more homogeneous unclassified group than W_4.

Again the total result is satisfactory and the work in problems as covered by this test seems to have been mastered by the majority of the pupils.

Let us now turn to the diagrams of each class and get a clearer picture of the results of each by a detailed study of percentage analysis.

Diagram 1 gives the percentage distribution of rights for $+P_2$. Part (A) is for Equations and Formula, (B) for Graphs, and (C) for Problems. The diagram should be read as follows: in part (C), for example, 15 percent of the group got 5 problems

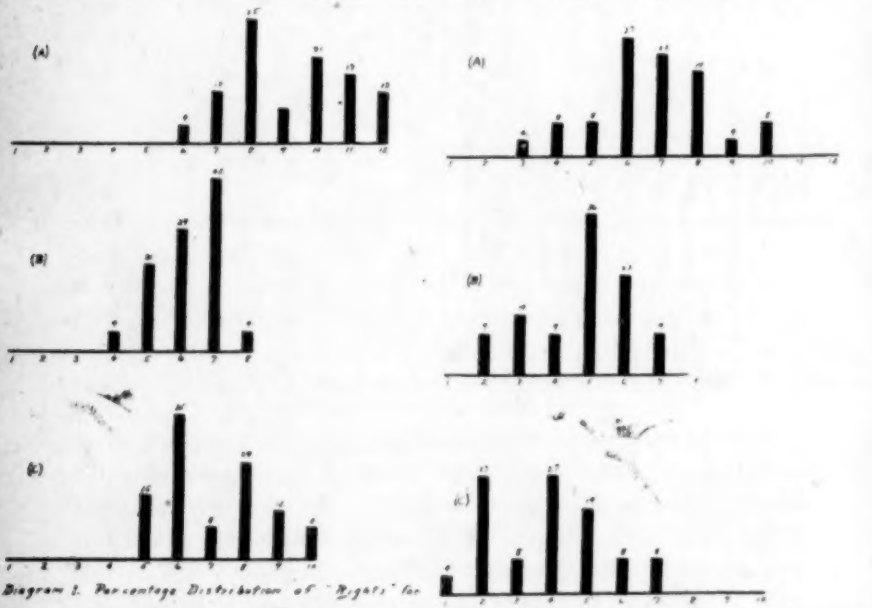


Diagram 1. Percentage Distribution of "Rights" for a + Mental Group, 3rd Period, Teacher P. (A) Equation and Formula, (B) Graphs, (C) Problems, in Hotz Algebra Scales.

Diagram 2. Percentage Distribution of "Rights" for a − Mental Group, 3rd Period, Teacher H.

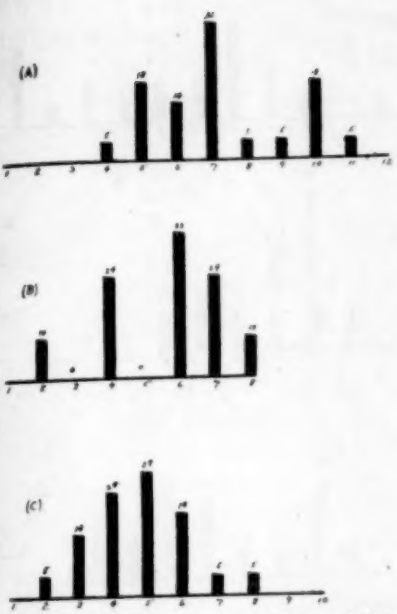


Diagram 3. Percentage Distribution of "Rights" for a Medium Mental Group, 5th Period, Teacher H.

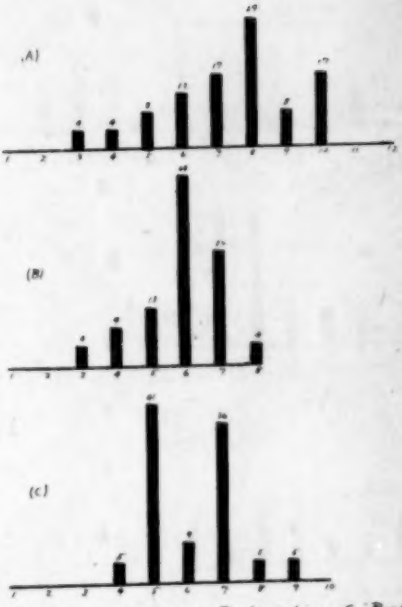


Diagram 4. Percentage Distribution of "Rights" for a + Mental Group, 7th Period, Teacher F.

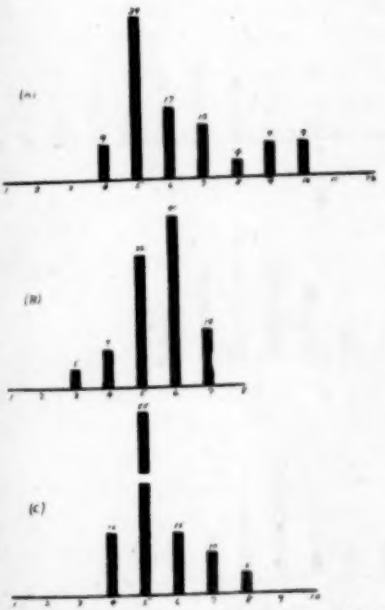


Diagram 5. Percentage Distribution of "Rights" for a − Mental Group, 5th Period, Teacher F.

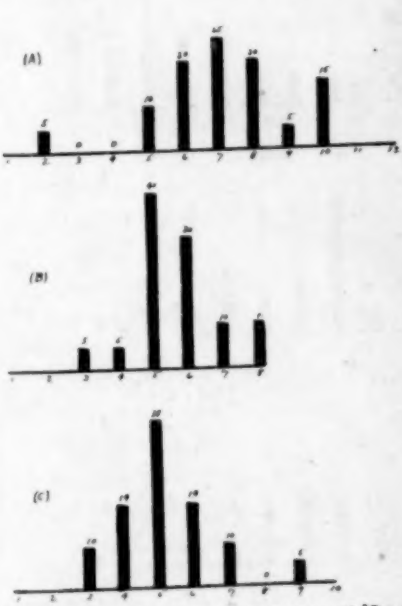


Diagram 6. Percentage Distribution of "Rights" for a Mixed Mental Group, 5th Period, Teacher M.

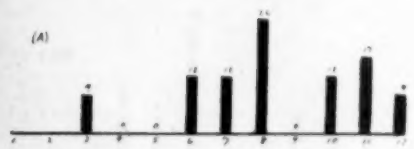


Diagram 7. Percentage Distribution of "Rights" for a Medium Mental Group, 2nd Period, Teacher W.

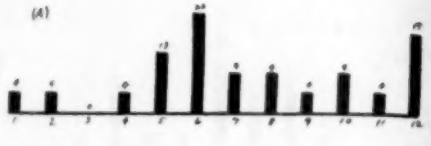


Diagram 8. Percentage Distribution of "Rights" for a Medium Mental Group 3rd Period Teacher W

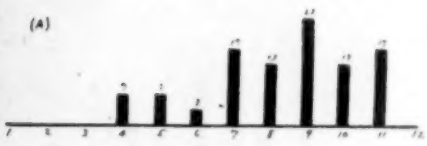


Diagram 9. Percentage Distribution of "Rights" for a Mixed Mental Group 4th Period Teacher W

Diagram 10. Percentage Distribution of "Rights" for All 9 Classes in the Mathematics Department

right, 35 per cent got 6 problems right, etc. At a single glance of (A), (B), and (C) one is struck with the marked ability of this group of pupils. They are distinctly superior pupils.

Diagram 2 gives the information about $-H_2$. Here we note a different story from $+P_2$. Part (A) is fair, but in (B), which, as stated before, is an easy test, one-third the class make a poor showing and another third only a fair showing. When it comes to part (C) which deals in problems requiring reasoning of a more complicated nature it is evident the pupils are lacking.

Diagram 3 shows the results of a medium group, mH_2. In part (A) there are a few cases of superior ability but taken as a whole the group is medium. In (B) the results are very gratifying, indicating that this type of work (graphs) seems to be effectively grasped by the average pupil. In (C) we see again a good medium showing.

Diagram 4 is another distribution of a +mental group, $+F_2$. Five-sixths of the class in (A) worked 6 problems or better, which is very satisfactory. In (B) three-fourths of the section make a very good showing. (C) reveals the fact that there are two rather distinct divisions of ability in the class, one of 5 problem ability and one of 7.

Diagram 5 gives the distribution for $-F_2$. This section, except perhaps for part (A), really shows evidence of medium ability and no doubt could have handled the work at that level. However, the fact that more than half the class in (C), which deals with reasoning, could only do 5 problems causes one to think that the group was slow in the reasoning process.

Diagram 6 is the distribution of a mixed or unclassified section, M_2. It shows more than average ability but has one or two pupils who are out of their element It might be of interest to state that nearly all the members of this group entered school in February of the previous year and had one semester of general mathematics before taking up algebra.

Diagram 7 is the distribution of the medium group mW_2. There seems to be considerable evidence that there are several very good pupils in this section who might have been worked more to capacity had they been in a +mental group.

Diagram 8, mW_3, shows a very great range of ability and thus is evidence of failure of an attempt at homogeneous grouping. This class was a difficult one to teach because it was a hard task to keep everyone working to capacity.

Diagram 9 is the distribution of an unclassified section, W_4,

and again shows a great range of ability. In part (C), especially, there appears to be no one degree of reasoning ability but a spread from the lowest to the highest.

Diagram 10 is a composite of all nine classes and shows that in a large group we find all kinds of abilities. Problems 9 in part (A) must have been a stumbling block for a good many as only 8 per cent got it.

If one has followed through the preceding analysis with any care he should be conv nced both from the tables and the diagrams presented that the check on classification is in most cases satisfactory but he must still bear in mind that classification does not always classify nor does it solve all the teaching problems.

AMERICAN CORN MAY SUPPLY OUR SUGAR.

Sugar from corn may soon be a reality on American breakfast tables. By a process devised at the Bureau of Chemistry, U. S. Department of Agriculture, maltose, an edible sugar, much sweeter than glucose, has been made from cornstarch. It may also be made from hominy or tapioca.

The process does not depend upon chemicals, but is in many respects similar to the natural conversion of starch to sugar in the cells of living plants or animals. The cornstarch is merely mixed with warm water to which malt has been added and the resulting product subjected to the same processes of clarification and evaporation required in the manufacture of cane sugar from sugar cane or sugar beets.

This action of malt has been known to chemists for many years, but has hitherto not been susceptible to commercial production. In practice the results were very uncertain and frequently the whole batch of material spoiled. But now the secret cause of all these troubles has been discovered by H. C. Gore of the Bureau of Chemistry and production of maltose from corn on a commercial scale equal to that of glucose is regarded as more than a possibility.

Too many hydrogen ions, not too many cooks, is what spoiled the broth of earlier workers, Mr. Gore found. Hydrogen ions are electrified hydrogen atoms. They split off from many chemical substances in solution, chiefly from acids. They make things taste sour. It is necessary to carry on the reaction in the presence of a certain and carefully controlled proportion of hydrogen ions. There is the trick of the thing by which Mr. Gore can produce nice white candy from the golden corn.

Maltose, although a sugar, is not the same as cane or beet sugar. Neither is it the same as glucose. It is more than twice as sweet as glucose and about three-fifths as sweet as cane or beet sugar. It is as wholesome and nourishing as they are.

The United States now consumes about 5,600,000 tons of sucrose, the sugar made from cane and sugar beets. Of this 2,800,000 tons are imported. In addition, we eat in the neighborhood of 1,000,000 tons of glucose. The importance of Mr. Gore's discovery lies in the possible replacement of some of the imported sucrose or home-made glucose by maltose, which is cheaper than sucrose, sweeter than glucose and apparently easier to prepare; and which can be produced from the almost inexhaustible source of American grown corn.

Commercial interests are showing interest in Mr. Gore's discovery and in one instance have offered part of their plant equipment for further experiments on a large scale.—*Science Service.*

MISTAKES IN THE COMPUTATION OF STANDARD DEVIATIONS.

By Walter C. Eells,
Whitman College, Walla Walla, Washington.

There is a very strange combination of mistakes in the solution of a problem in finding the standard deviation of two distributions in C. A. Gregory's new volume, *Fundamentals of Educational Measurement with the Elements of Statistical Method* (D. Appleton & Co., New York and London, 1922), and in the leading article in School Science and Mathematics for November, 1919, "A Practical Method for Demonstrating the Error of Mean Square," by H. F. Roberts.

In this admirable article Mr. Roberts gives as one exceedingly illuminating example, the following (p. 687):

"It is stated that formerly, in the Belgian army, the scores at rifle practice were determined by adding together the distance of each man's shots from the center of the target, the marksman having the smallest sum becoming the winner. Suppose, however, we had, in a series of shots, the following records. Let A and B be two riflemen:

Shot No.	*Distances of shots from center of target in inches.*	
	A.	*B.*
1	2	4
2	8	5
3	3	6
4	7	4
5	9	3
6	4	5
7	2	5
8	5	6
9	9	7
10	1	5
	50	50

According to the sum of the distances of their respective shots from the center of the target, A and B form a tie. When, however, we apply the test of the error of mean square to their shooting, we find that A has a standard deviation of 2.10 inches, while B has the much lower standard deviation of 1.09 inches, and he is thus shown to be the more reliable shot."

The problem is also illustrated by a diagram showing the distribution of the shots. Gregory in the work mentioned (pp. 318-320) in order to "show the significance of mean and standard deviations graphically" copies this illuminating problem, and then, unlike Roberts, works it out in detail instead of merely stating results and finds that the standard deviations for A and B are 5.77 and 5.11 respectively!

It is interesting to note that there are five errors in the statement and solution of this problem in the two sources quoted.

(1) In Roberts, standard deviation for A is not 2.10
(2) In Roberts, standard deviation for B is not 1.09
(3) In Gregory, the problem is incorrectly copied, the seventh shot for A being given as 9 instead of 2, but the total still given as 50.
(4) In Gregory, standard deviation for A is not 5.77
(5) In Gregory, standard deviation for B is not 5.11

No. 3, in Gregory, is probably a typographical error only. But it was the existence of this error which led to a discovery of the other more serious ones in Roberts' article. The problem as stated in Gregory was copied and given to the author's class in statistical methods who at once found that the sum of the deviations was *not* 50 for A's shots. It was this experience with the class that led the author to re-examine Gregory's solution, and the original article upon which it was based.

Gregory's other two errors, (4) and (5), are in error by only 0.01 each, but are excellent illustrations of the tendency of students to take the *next smaller* value rather than the *nearest* value when dropping decimals. The sums of the squared deviations divided by their number, in the two cases are 33.4 and 26.2 respectively. The square roots of these two numbers to three places are (by Barlow's Tables) 5.779 and 5.119. If the result is desired to two places only, then the correct forms to use are 5.78 and 5.12 respectively, instead of 5.77 and 5.11.

Roberts' errors, however, are much more serious. Since he does not give the steps in his solution there is no way to find how he arrived at such remarkable values. If, in accordance with the common principle of least squares, we assign weights to A and B "inversely proportional to the squares of their probable errors" (See WELD, *Theory of Errors and Least Squares*, p. 156, probable errors being proportional to standard deviations), then A is about *four times* as reliable a shot as B, a result which is obviously incorrect either from an inspection of the diagram given or from a consideration of the equality of the sums of the two sets of deviations. If the markmenships of the two men are weighted inversely proportional to the squares of their true probable errors, it is found that A is a better shot than B in the approximate ratio of 19 to 15, or roughly, four to three, which of course is a much more reasonable result.

There is another group of errors in Roberts' article. He gives two examples to illustrate the meaning of standard deviation and the methods for computing it. The second of these examples is the one already discussed. The first one is with reference to

seventeen measurements of a certain wave length, the data being given in seventeen lines like the following first line:

V	D	D^2
4.524	0.0185	.00034225

The average is given as 4.5048; the sum of the D^2's as .00173825. The last line then reads,

".00173825/17 = 0.00101 (the standard deviation)"

This single line has three mistakes in it—(1) In the decimal point—the first four figures are .0001; (2) In the numerical value of the quotient—which should be 0.000102+ (0.00010225); (3) Most serious of all, in the statement that this quotient is the standard deviation—it is actually the square of the standard deviation, as it is the sum of the D^2's, divided by their number.

In a statement at the top of the same page of Roberts' article a correct definition of the standard deviation is given, quoted from Karl Pearson's Grammar of Science, but immediately following it Roberts gives it as a formula which is wrong. The formula as printed is

$$\sigma = \frac{\sqrt{\Sigma(d^2f)}}{n}$$

whereas it should be

$$\sigma = \sqrt{\frac{\Sigma(d^2f)}{n}}$$

(Italic "*o*" is also given for "o" in explaining the meaning of this notation.) But neither of these two forms will justify the statement in the last line of the solved problem.

There are other numerical difficulties in the problem as solved. The average is stated in two places as 4.5048. As a matter of fact it is not this, but 4.5054 (4.50541+)! The author says "The second column gives the residuals, or differences between each measurement and the mean (A = 4.5048)." An examination of the second column will show, however, that it is actually composed of residuals from 4.5055, virtually the true average! Another error is found in comparing the seventeenth and fourteenth lines. The fourteenth line reads:

4.504	0.0015	.00000225

The seventeenth line reads:

4.504	0.0005( )	.00000025

It is evidently the seventeenth line that is in error.

When these various corrections are made, it is found that the standard deviation for the first illustrative problem is 0.0101

(0.01012). This is about 1¼ times the mean or average error (0.0083), as it should be in a normal distribution. In a normal distribution about two-thirds of the errors should be less than the standard deviation, and in this case it is found by actual count that 11 of the 17 are less.

It is unfortunate that this article which is so admirably conceived and otherwise so splendidly worked out, should be so badly in error in the numerical processes and results expressed as to make it difficult for one not already thoroughly familiar with the computation of the standard deviation to follow the illustrative numerical examples.

TO DEVELOP RESPECT FOR MANUAL PROFESSIONS.

In France, as in many other countries, the existence of a certain prejudice against manual labor has led many young men to seek clerical situations which, owing to the large number of candidates, are underpaid. Under these circumstances it is evident that any action tending to a more economical distribution of labor is beneficial not only to the individual but also to the community.

With this object in view the municipal authorities of Troyes and commercial and trade organizations established a Chamber of Trades. The activity of the chamber was first directed toward a reform in apprenticeship. Under a special form of contract the employer must deposit with the chamber a sum equal to one-fifth of the wages of the apprentice. This sum together with interest thereon is paid to the apprentice when he has completed his contract.

It has been arranged that teachers in the public schools keep records showing aptitudes of pupils, and several hundred pupils have been thus aided in the choice of a manual profession.—*School Life*.

AMERICAN DRUG MAY BE SUBSTITUTE FOR GERMAN.

Discovery that an American drug, tryparsamide, developed in the Rockefeller Institute and used in the treatment of paresis, can be substituted temporarily for the German drug used in the treatment of African sleeping sickness has been announded in London, according to a report just received by the American Medical Association.

The German drug is known as Bayer 205. Its formula is a carefully guarded secret which it has been hinted Germany would be willing to trade for the recovery of her former African possessions. Immense areas of central Africa have become unfit for human habitation because of the prevalence of the sleeping sickness, which is caused by a parasite carried by the tsetse fly, and Bayer 205 is claimed by its inventors to be a specific cure for the disease. It was brought out in the discussion in London that while its exact composition is unknown, it is known to be a complex organic anilin substance of which the nucleus is trypan blue.

Some animals and men on whom Bayer 205 was used became drug fast, or resistant to the effects of the drug. Attempts to overcome this condition have resulted in the discovery that other remedies such as antimony tartrate or tryparsamide may be substituted temporarily for Bayer 205. —*Science Service*

USES OF THE ASPIRATOR.

By H. J. WING,

High School, University Place, Nebr.

Who of you have never had the enjoyable experience of working the ancient exhaust pump hoping to demonstrate some of the vacuum phenomena only to find that something is leaking and all that labor lost? Even though the fault is quickly repaired the prospect of further exercise under the admiring eyes of the class is not over alluring and in the press of time the demonstration may never be performed.

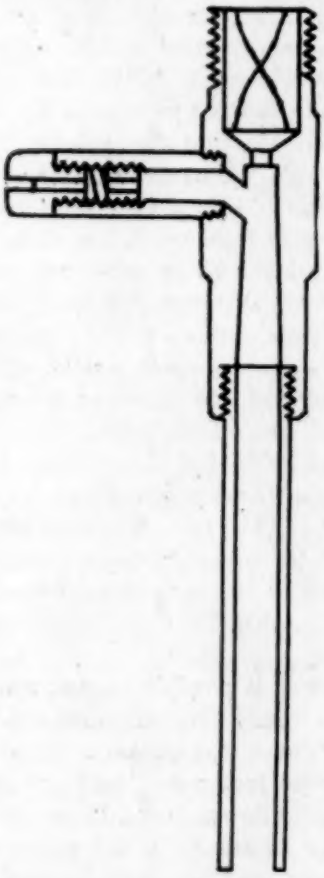


FIG. 1. THE ASPIRATOR

Many high school science teachers have never used that labor saving device the aspirator, commonly called a water pump. This instrument may be used in enough ways to well

repay for the investment in one, where the laboratory is supplied with running water.

A former article, (School Science and Math., January, 1923) pointed out its use as a source of supply for compressed air in the laboratory. This one will outline some further uses of the instrument and explain its mechanism.

The instrument owes its ability to create a vacuum to the fact that a rapidly moving stream of fluid in passing through a tube is carried, by the inertia of its own mass, past an opening in the side of the tube.

However gases or liquids in this side tube are caught by the rapidly moving stream and carried with it. When a liquid is moving most rapidly the pressure is the least so the speed of the water stream is made as great as possible by constructing the tube at the place where the side tube enters. Fig. 1. The tube is then expanded so that the water is traveling much more slowly as it reaches the air. This makes the pressure at the point of entrance of the side tube much less than one atmosphere and the result is that the air or other gas rushes in and is carried out by the stream of water. A good instrument is capable of creating a vacuum down to the aqueous tension of the tap water. The vapor pressure varies with the temperature of the water but with the water at a temperature of 15°C. this pressure is 12.7 mm. of mercury.

This degree of exhaustion is far better than that usually obtained by the mechanical hand pump of the majority of the high school laboratories. This fact together with the ease of operation of the aspirator make its use a great convenience in demonstrating the various vacuum phenomena such as the Magdeberg hemispheres, cause of the rise of liquids in exhausted tubes, etc.

By use of the aspirator it is possible to demonstrate boiling in vacuo and by using a vessel with sulphuric acid in the line in order to still further lower the pressure by absorbing the water vapor, water may be frozen by "boiling" and the phenomena of electric discharge in exhausted tubes may be shown.

A liquid which is very necessary in the physics laboratory and one which very easily becomes contaminated is mercury. It is possible to make the dirtiest mercury purer than the product sold to high schools without any complicated apparatus. The only pieces needed being a strong bottle, the aspirator, a two hole rubber stopper, some glass tubing and a little sulphuric acid.

The mercury is placed in the bottle and covered with a layer of dilute sulphuric acid. The apparatus is set up as shown in Fig. 2. Tube A is drawn out to a capillary of about 1 mm. bore. This tube extends to the bottom of the bottle with the small end down and the large end open to the air. Tube B reaches just through the stopper and is connected to the aspirator by means of a piece of rubber tubing.

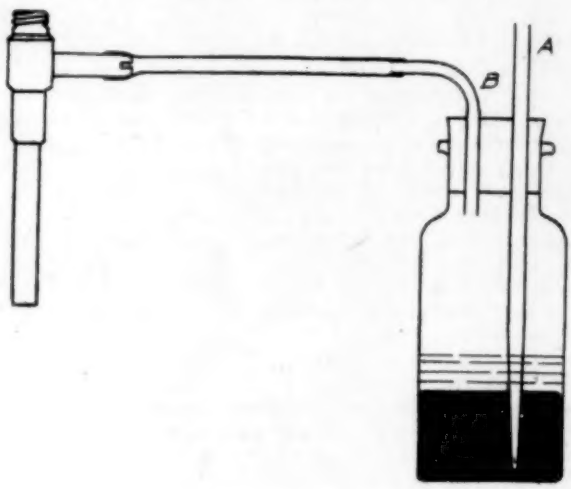


FIG 2.

Upon starting the aspirator, air is drawn through the mercury and in this way stirs it, mixing the acid and mercury. Care must be taken to see that none splashes over and is drawn through the pump for if the plumbing is of lead the mercury will very quickly eat it out.

The sulphuric acid oxidizes any foreign metals which may have been present in the mercury as well as any grease or other organic matter. There soon appears a black scum on the mercury. This is the oxidized impurities. It is always well to use two or three different portions of the acid and the stirring should be continued for several hours, the length of time determining the purity of the product.

When the acid seems to have no further effect on the mercury, wash several times with pure water stirring well with each washing. Decant the supernatant liquid or separate the two by means of a separatory funnel. For the final separation, run the mercury through a filter paper pierced with pin holes taking care to leave all the black residue on the filter. The product will be far cleaner than that which the supply

houses sell as their ordinary mercury, so that if mercury is required for barometer filling or other exact work better results will be obtained if this process is applied to the material before use.

These are but a few of the many useful tasks which this rather neglected piece of apparatus may be called upon to perform.

FINDS CORAL ISLANDS BUILT BY MEAT EATING ANIMALS.

The builders of coral reefs and islands are entirely meat eating animals, Dr. T. Wayland Vaughan, of the United States Geological Survey told the Pan-Pacific Science Congress, at its recent meeting in Melbourne, Australia. In experiments conducted by him in the Tortugas in the Gulf of Mexico, corals persistently refused a vegetable diet, but even water fleas were not swift enough to dodge the lightning-like tentacles of these carnivorous creatures.

The living coral is a branched colony of individuals all connected together and with their soft bodies encased in strong shells. Each individual is little more than a stomach, with a mouth surrounded by tentacles and sheltered in a little cup of the limey skeleton within which the whole colony is enclosed.

Dr. Vaughan described how when a little beef juice or a small bit of meat, usually crab flesh or fish, was offered, the tentacles at the outer edge of the colony would begin to appear. Then the stimulus was transmitted to other members of the colony until soon the surface of the specimen had opened out like a beautiful flower. This condition, he explains, seems to indicate that the coral colony is hungry and ready to capture food.

Corals have special mechanisms for catching food including tentacles containing stinging cells and cilia, or hair-like extensions of the outer layer of the soft tissue which in response to certain stimuli beat toward the mouth opening; and in response to others beat away from it. The outer surface also secrets mucus in which particles of food may be embedded and this mucus is moved by the beat of the cilia either toward or away from the mouth.

Many different kinds of food were offered coral, Dr. Vaughan said, but they took only animal food. A piece of diatom mat was placed on one side of the coral disc, between the tentacles and the mouth, and a piece of crab meat on the other. Invariably the crab meat was seized and swallowed; while the diatoms induced no reaction except ultimately to be removed from the surface. No kind of purely vegetable food was taken by any one of the numerous species investigated. Pieces of plants coated with small animals soaked in meat juice were swallowed but later the vegetable matter was ejected.

When hunger is entirely satisfied, the tentacles retract and the ciliary motion reverses and particles of food are moved away toward the outside edge of the colony.

At the rate of upward growth observed in the reefs of the West Indies it would take from 6,531 to 7,620 years for the formation of a reef 150 feet thick in one of the species examined, while another could build the same thickness of reef in 1,800 years, while some of the Pacific forms grow still more rapidly and might accomplish as much in 1,000 years.—[*Science Service.*

LIFE ACTIVITIES AND THE PHYSICS CURRICULUM

M. E. HERRIOTT,

Supervisor of Science, University High School, Columbia, Mo.

One big question which has long puzzled teachers of physics and administrators in our high schools has been whether physics should be taught to boys and girls together or in segregated classes. This goes further back to another question, Should physics be taught to girls at all? It also hinges on two other questions, Should there be any difference in the manner of treatment for boys and for girls? And, should there be any difference in the order of emphasis or in the sequence of topics for boys and for girls?

The results of a recent investigation by the author point toward satisfactory answers to all of these questions.[1]

In this study a list was made of 576 activities involving elements of physics which are carried on in everyday life. This list was divided into three shorter ones.

The first one of these three lists included those things which people often have others do for them, such as, "Test the charge of storage batteries with a hydrometer" and "Adjust radiators so as to stop 'hammering' ".

The second list included those things which people either do for themselves or else they are not done, such as, "Keep permanent magnets when not in use" and "Buy an electric motor."

The third list included those things about which people think, such as "Why we 'hear the ocean' in a sea shell" and "How a submarine can be made to sink or float at will."

These lists were then checked by people in various walks of life so as to indicate the extent to which the activities listed entered into their lives. For the purposes of the study, those marking the questionnaire were divided into six groups:

(1) Boys of high-school age.
(2) Men of laboring occupations.
(3) Men of sedentary occupations.
(4) Girls of high-school age.
(5) Women not housewives.
(6) Housewives.

The data gathered were tabulated and the accompanying graph was constructed from a summary table. This graph shows the relative interests of the various groups of people in the different sections of physics as exhibited by their answers

[1] "Life Activities and the Physics Curriculum," Master's Thesis, University of Missouri, 1923

to the questionnaire. The conclusions which were drawn from the data appear graphically, but may be stated as follows:

(1) Physics as a whole enters to the greatest extent into the life of boys, second, into the life of men, third, into the life of girls, and least into the life of women.

(2) Activities involving the principles of Sound and Light enter more largely into the life of girls and women than into the life of boys and men.

(3) Activities involving the principles of Mechanics, Heat, Magnetism and Electricity, and Invisible Radiations are preponderantly participated in by boys and men, with boys distinctly leading.

(4) Boys, laboring men, and housewives tend to do things themselves if they know how, while men of sedentary occupations, women who are not housewives, and girls tend to have others do things for them even when they know how.

(5) Although principles of physics enter quite largely into the life of girls, yet they are not doing a great deal that involves physical principles. Rather, they are having such things done for them. But they are thinking to a considerable extent about things which involve principles of physics.

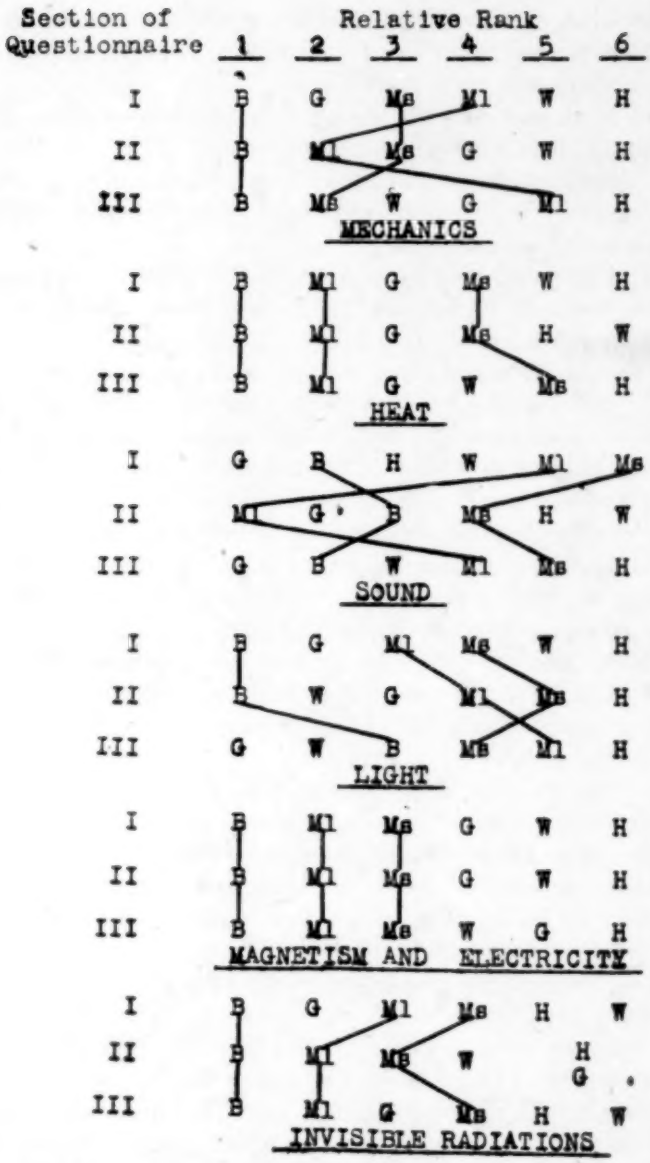
It does not stand out so distinctly in the summary material presented here as in the more detailed data of the investigation, but physics does enter quite largely into the life of girls and women, and they are vitally interested in things involving physics, although not to the extent to which boys and men are interested. From this one may readily answer that physics should be taught to girls.

It is obvious that there is so much difference in the interests of boys and girls that differences should be made in the order of emphasis and manner of treatment in teaching high-school physics to boys and girls. All of which leads to the conclusion that boys and girls should be segregated in teaching physics.

The above answers and the following suggestions, in which they are embodied, are based upon two fundamental assumptions: (1) that physics should be based upon the interests and knowledge of those taught, and (2) that it should be made to function in their lives.

The following recommendations are based upon the foregoing conclusions which have been drawn from the entire investigation.

In teaching high-school physics it is recommended:


Section of Questionnaire
Relative Rank
1 2 3 4 5 6
I B G Ms Ml W H
II B Ml Ms G W H
III B Ms W G Ml H
MECHANICS
I B Ml G Ms W H
II B Ml G Ms H W
III B Ml G W Ms H
HEAT
I G B H W Ml Ms
II Ml G B Ms H W
III G B W Ml Ms H
SOUND
I B G Ml Ms W H
II B W G Ml Ms H
III G W B Ms Ml H
LIGHT
I B Ml Ms G W H
II B Ml Ms G W H
III B Ml Ms W G H
MAGNETISM AND ELECTRICITY
I B G Ml Ms H W
II B Ml Ms W H G
III B Ml G Ms H W
INVISIBLE RADIATIONS

Graph showing the relative interest of various groups of people in the six sections of physics as shown by their answers to the questionnaire. The graph reads: Boys and men show the greater interest in Mechanics, while girls and women show the greater interest in Sound and Light. Legend:

B—Boys
G—Girls
H—Housewives
Ml—Men of Laboring Occupations
Ms—Men of Sedentary Occupations
W—Women not Housewives

(1) That physics, as now taught in the high school, should be given primarily to boys, because physical principles and facts enter most largely into their life.

(2) Boys and girls should be segregated in physics classes because of their different centers of interest.

(3) In boys' classes the order of emphasis should be: Magnetism and Electricity, Invisible Radiations, Mechanics, Heat, Sound, and Light.

(4) In girls' classes the order of emphas s should be: Light, Sound, Invisible Radiations. Mechanics, Heat, and Magnetism and Electricity.

It should be noted that the order of emphasis for girls is almost the complete reversal of the order of emphasis for boys.

Recommendations (3) and (4) are based upon the apparent order of interest as shown in the graph. These two sequences might well also be the order of treatment in either case, although the recommendations are only for order of emphasis.

(5) In boys' classes the manner of treatmen should be such as to involve the actual operation of physical principles with apparatus handled by the boys.

(6) In girls' classes the manner of treatment should be more that of answering intellectual curiosity and demonstration, rather than the actual physical participation on the part of the girls.

(7) Physics should be taught in such a way as to answer, or help the pupil to answer, a great many questions which involve some knowledge of physics, but which do not require a closely organized system of laws for a satisfactory understanding. This in addition to much of the more closely organized work already taught.

These recommendations are made with the full knowledge that they are impossible of full realization in the average high school where there is but one class in physics and segregation is impossible. There, one of two things may be done. Physics may be given in alternate years to boys and girls. Or they may be divided within the class, the sequence being that best suited to the majority of the class, assignments being made to especially suit groups and individuals, and boys doing most of the manipulation while girls are held responsible for results when assigned with boys.

The latter plan is being followed in the organization and teaching of the physics course in the University High School. The results are the most satisfactory ever obtained by the author.

PROBLEM DEPARTMENT.

CONDUCTED BY J. A. NYBERG.

Hyde Park High School, Chicago.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and solve problems here proposed. Problems and solutions will be credited to their authors. Each solution, or proposed problem, sent to the Editor should have the author's name introducing the problem or solution *as on the following pages.*

The Editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to J. A. Nyberg, Hyde Park High School, Chicago

LATE SOLUTIONS.

821. *Chas. Oergel, Drexel Institute, Philadelphia, Pa.*

SOLUTIONS OF PROBLEMS.

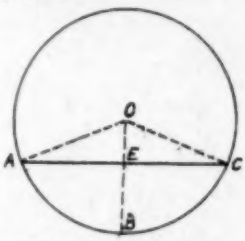
817. *N. H. Mewaldt, State Normal School, Dickinson, N. D.*, calls attention to an error in the second solution of this problem published in April. For $n = 10$, the sum of the terms is 1234567900 not 1234567890. The solution is correct only for $n<10$.

In the third solution the value of $(t-1)^2$ is 81 not 99 and hence the last fraction should have 9 in the denominator instead of 11.

826. *Proposed by E. Rae, San Jose, California.*

Given a cylindrical oil tank with its axis horizontal. An aperture in the top permits the introduction, vertically, of a measuring rod whereby the depth of the oil may be ascertained. Find a formula giving the number of gallons in the tank in terms of l, the length in feet of the cylinder, r the radius of one end, and d the measured depth.

Find also a similar formula giving the approximate contents when the axis of the cylinder is inclined at a given angle and the depth measured at the point where it is greatest.



Solved by George Gatje, Islip, New York.

The segment ABCA = sector OABC $-$ $\triangle$ACO.

The area of the sector is to the area of the circle, πr^2, as $\angle$AOC is to 360, and $\angle$AOC is twice the angle whose cosine is OE/OA or $(r-d)/r$. Hence sector OABC $= (\pi r^2/180)$ arc cos $(r-d)/r$.

$\triangle$ACO $=$ OE $\times$ AE $= (r-d)\sqrt{r^2-(r-d)^2}$.

The desired formula is therefore

$$G = \left[\frac{\pi r^2}{180} \text{ arc cos } \frac{r-d}{r} - (r-d)\sqrt{2rd-d^2}\right]\frac{1728l}{231}.$$

This formula is also correct when $d>r$, that is, when the tank is more than half full but we must then remember that $\angle$AOE is an obtuse angle since $(r-d)<0$, and that the second term in the bracket will actually become $+(d-r)\sqrt{2rd-d^2}$.

Also solved by *J. F. Howard, San Antonio, Texas*, and *J. Murray Barbour, Ardmore, Pa., Edna Beard* and *Good Hardin*, pupils of the *Brownfield H. S., Texas*, solved numerical cases using the formula $\frac{4}{3}d^2\sqrt{(2r/d)-1.608}$ which is an approximation for the above

formula. No satisfactory solution was received for the case wherein the tank is tilted at an angle.

827. *Proposed by N. Anning, Ann Arbor, Michigan.*

Find the cubic with rational coefficients of which $x = \sqrt[3]{2}+\sqrt[3]{4}$ is a root.

I. *Solved by Myra E. Wasser, Burlington, Iowa.*

If $x = \sqrt[3]{2}+\sqrt[3]{4}$ then $x^3 = \sqrt[3]{8}+3\sqrt[3]{4}\sqrt[3]{4}+3\sqrt[3]{2}\sqrt[3]{16}+\sqrt[3]{64} = 6\sqrt[3]{2}+6\sqrt[3]{4}+6 = 6(\sqrt[3]{2}+\sqrt[3]{4})+6 = 6x+6$.

Hence the required equation is $x^3-6x-6 = 0$

II. *Solved by Michael Goldberg, Philadelphia, Pa.*

Let $a = \sqrt[3]{2}$, $b = \sqrt[3]{4} = a^2$.

Then $x = a+b$; $x^2 = a^2+2ab+b^2 = b+4+2a$; $x^3 = 6a+6b+6$.

If the required equation is $px^3+qx^2+rx+s = 0$ or $p(6b+6a+6)+q(b+2a+4)+r(a+b)+s = 0$, then in order to be rational the coefficients of a and b must be zero, or $6p+q+r = 0$ and $6p+2q+r = 0$. A possible solution of these equations is $q = 0$, $p = 1$, $r = -6$, $s = -6$. Therefore the required equation is $x^3-6x-6 = 0$.

Also solved by *J. Murray Barbour* and *J. F. Howard.* The second solution shows the more general method.

828. *Proposed by C. E. Githens, Wheeling, West Virginia.*

Prove that $4^{3n+1}+2^{3n+1}+1$ is divisible by 7 for integral values of x.

I. *Solved by R. T. McGregor, Elk Grove, California.*

Let $f(x) = 4^{3n+1}+2^{3n+1}+1 = 2^{6n+2}+2^{3n+1}+1$

Then $f(x+1) = 2^{6n+8}+2^{3n+4}+1$, and

$f(x+1)-f(x) = 2^{6n+8}-2^{6n+2}+2^{3n+4}-2^{3n+1}$

$= (2^6-1)2^{6n+2}+(2^3-1)2^{3n+1}$

which is evidently a multiple of 7 because $2^6-1 = 63$ and $2^3-1 = 7$. Hence if $f(x)$ is divisible by 7, so also is $f(x+1)$. By trial we find that $f(x)$ is divisible by 7 when $x = 1$. Hence by mathematical induction $f(x+1)$ is divisible by 7.

Similarly proved by *F. S. Gachet, University, Alabama,* and *Michael Goldberg.*

II. *Solved by J. Murray Barbour, Ardmore, Pennsylvania.*

$2^{3x} = 8^x = (7+1)^x$ and each term in the binomial expansion of this quantity is divisible by 7 except the last term, which is 1.

Hence $2^{3x} = 7k+1$, and $2^{3x+1} = 14k+2$.

Also $4^{3x} = (7k+1)^2 = 49k^2+14k+1$ and $4^{3x+1} = 4(49k^2+14k)+4$

Hence $4^{3x+1}+2^{3x+1}+1 = 4(49k^2+14k)+4$
$+14k+2$
$+1$

which shows that the given expression is divisible by 7.

Similarly solved by *F. A. Cadwell, St. Paul, Minn.* Also solved by *J. F. Howard* and the *Proposer. Hazel C. Jones, Attica, Indiana,* mentions that x must be integral; with $x = \frac{2}{3}$, for example, $4^3+2^3+1 = 73$.

829. *Proposed by J. F. Howard, San Antonio, Texas.*

Circumscribe a square about a given quadrilateral.

I. *Solved by M. Freed, Wilmington H. S., Los Angeles, Cal.*

Analysis. Let PQRS be the required square and ABCD the given quadrilateral. Draw the diagonals AC and BD. From A draw $AE \perp BD$. Draw $AF \perp RS$ and $DG \perp PQ$. Then $AF = DG$ and $\angle GDB = \angle FAE$, their sides being respectively perpendicular. Hence $\triangle GDB = \triangle FAE$, and therefore $AE = BD$.

Construction. Draw BD. Draw $AE \perp BD$ and $AE = BD$. Draw CE, and through A a line $\parallel CE$. Through B and D draw perpendiculars to these parallel lines forming the desired square PQRS.

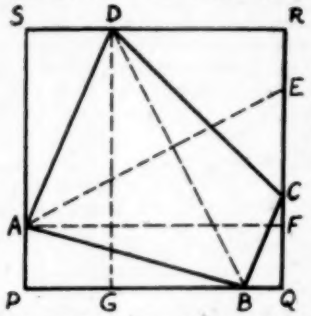
Since $AE = BD$, by construction, we can reverse the analysis and prove $AF = DG$. Hence the figure is a square.

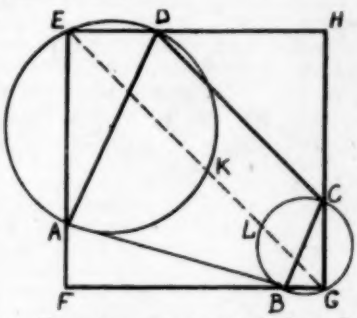
Similarly constructed by *Michael Goldberg.*

II. *Solved by the Proposer.*

Analysis. Since $\angle DEA$ is a right angle the circle drawn on AD as a diameter passes through E; likewise G lies on the circle whose diameter is

BC. Since EG is a diagonal of the square it bisects ∠DEA and ∠BGC. Hence arc AK = arc KD and arc BL = arc LC.





Construction. On AD and BC as diameters construct circles. Let K be the midpoint of arc AD and L the midpoint of arc BC. Draw KL and prolong it to intersect the circles in E and G. Draw EA, ED, GB, GC and form a square.

The figure is a square since ∠HEG = ∠HGE, etc.

830. *For High School Pupils. Proposed by Paul Ligda, Oakland, California.*

A contractor has to remove 2000 tons of rock in 22 days. His steam shovel can remove 63 tons a day. He can rent for $50 a day another shovel which can remove 126 tons a day, but the excavation is narrow so that he can use only one shovel at a time. How much does he pay in rent for the larger shovel if he uses his own shovel as much as possible?

Solved by Ryan Ezell, Boiling Springs, North Carolina.

x = No. days using own shovel
$22-x$ = No. days using hired shovel
$63x$ = No. tons carried out with own shovel
$126(22-x)$ = No. tons carried out with hired shovel

$$63x+2772-126x = 2000 \text{ No. of lbs. to be moved}$$
$$-63x = -772$$
$$63x = 772$$
$$x = 12\tfrac{16}{63}$$
$$22-x = 9\tfrac{47}{63}$$

$9\frac{47}{63}\times\$50 = \$487.30$ rent due for hired shovel.

Also solved by *Faneta Smith, Northeast H. S., Kansas City, Mo.*, using two unknowns x and y

Pupils and teachers may be interested in finding the error in the following solution which was typical of many:

2000 − number of tons which must be removed in 1 day.

63 tons − amount his steam shovel can remove in 1 day.

$2000\div 22 = 90\frac{10}{11}$ number of tons which must be removed in 1 day.

$90\frac{10}{11}-63 = 27\frac{10}{11}$ number of tons left to be done by large shovel.

$27\frac{10}{11}+126$ = part of day large shovel was used.

$22\times 27\frac{10}{11}\div 126 = \frac{614}{126}$ or $4\frac{55}{63}$ number of days large shovel was used.

$50 rent per day for large shovel.

$50\times 4\frac{55}{63} = \$243.65$ amount paid in rent for large shovel.

The editor expected to see a few graphical solutions based on drawing a line with slope 63 through the origin and a line with slope 126 through the point (22, 2000). But no one used the graphical method perhaps because the numbers in the problem were too large. The editor was also

interested in seeing how many pupils would use two unknowns and how many only one unknown. But the results were just half-and-half. There were unnumerable mistakes with fractions. The editor also concludes that problems from geometry are more interesting than problems in algebra as last month there were 20 correct solutions from 12 schools in 8 states, and in April there were 17 solutions and 9 states represented.

PROBLEMS FOR SOLUTIONS.

841. *Proposed by Walter H. Carnahan, Bloomington, Ind.*

In $\triangle ABC$, $\angle C = 90°$. On AC the square ACDE is constructed, and on BC the square BCFG. The altitude to the hypotenuse is CH. Prove that the lines BE, AG, CH are concurrent. [I find this problem written on a fly leaf in a book purchased from the library of the late Prof. Beaman of the University of Michigan. *Proposer.*]

842. *Proposed by Arthur H. Lord, Classical H. S., Lynn, Mass.*

Under what conditions will the three sides of a right triangle, the altitude on the hypotenuse, and the segments of the hypotenuse all be integral? be rational? [The problem about the integral character of the sides of a right triangle has been frequently discussed. In this problem the altitude and the segments of the hypotenuse are also to be integral, or rational.—*Ed.*]

843. *Proposed by J. F. Howard, San Antonio, Texas.*

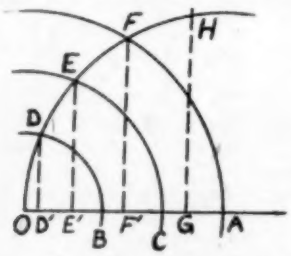
Ten persons each name a number not greater than 10. Find the chance (1) that no two persons shall name the same number, (2) that all ten shall name the same number.

844. *Proposed by Harry Frye, Tullahoma, Tenn.*

Prove the correctness of the following method for finding the radius of a circle whose area is the sum of the areas of several circles:

Let OA be the radius of the largest of the given circles and OB, OC the radii of the other given circles. With A as a center and AO as a radius draw an arc intersecting the circles at D, E, and F. From D, E, F draw the perpendiculars DD′, EE′, FF′ to OA. From F′ measure F′G = OD′ + OE′. At G draw a perpendicular intersecting the arc at H. Then the line OH is the desired radius.

Three circles are used here to illustrate the generality of the method. In a proof it would be naturally sufficient to deal only with two circles.



845. *For High School Pupils. Proposed by Louis Sklar, Philadelphia, Pa*

Three equal circles are tangent to each other. The area between the three circles is 1 sq. in. Find the radius of the circles.

More than half of the children of school age in Cuba do not receive any education at all, according to a message from the President of the Republic to the Congress. It is estimated that more than 12,000 new classrooms are needed to provide places for these children. Many owners of buildings have offered free classroom space to boards of education, and additional classes will be installed as early as possible. By the provisions of a law passed in July, 1923, it is now possible to remedy in part the great shortage of teachers, which has been one of the greatest problems in Cuban education.

SCIENCE QUESTIONS.

Conducted by Franklin T. Jones.

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QUESTIONS FOR SOLUTION.

445. *Proposed by E. A. Rae, San Jose, Cal.*

Given two equal quantities of two liquids which have different specific gravities but which are capable of mixing with each other by diffusion. (For example, the liquids in a gravity cell.) Suppose them placed carefully in a cylindrical jar, with the heavier liquid below. The geometric volumes occupied by the two liquids are congruent. The center of gravity of each is at its center of symmetry. The center of gravity of the two liquids regarded as a whole lies on a line joining the individual centers of gravity, and at a point which divides this line into segments proportional to the specific gravities of the liquids. Evidently this point is below the horizontal plane separating the liquids. Now let diffusion take place. After the mixture has come to the same specific gravity throughout, the center of gravity will be in the horizontal plane which formerly separated the two liquids. That is to say, the center of gravity has been raised. Raising the center of gravity is equivalent to raising the entire mass. Whence came the energy to do this work?

446. *Proposed by F. Jehle, Cleveland, Ohio.*

(1) How many pounds of water do you produce in a gas engine for every pound of gasoline you burn?

(2) What is the volume of the exhaust?

(a) At same temperature and pressure?

(b) At combustion temperature (about 3000°F.)?

(3) What is the pressure developed at the moment of combustion?

447. *Proposed by James W. Wilbur, Peoria, Ill.*

Imagine a rectangular stick, such as a $2'' \times 4''$, extending a given distance, as 6 feet, horizontally from a flat roof, there being a weight of 200 lbs. at the outer end and the part on the roof being held down by a force 10 feet from the edge of the roof.

Analyze the forces tending to rupture the stick at the edge of the roof and assign their numerical values.

EXAMINATION PAPERS.

THE UNIVERSITY OF QUEENSLAND.

Senior Public Examination, November, 1921.

Applied Mechanics.

TIME ALLOWED—THREE HOURS.

The slide rule may be used.

1. A beam 20 ft. long is supported at the left-hand end and at a point 5 ft. from the right-hand end. There are loads of 10 tons at the centre, of 5 tons at the right-hand end, and of 20 tons uniformly distributed over the length of the beam.

(*a*) Find the reactions.

(*b*) Draw the shearing force diagram.

(*c*) Draw the bending moment diagram.

2. A boiler is 6 ft. diameter and has flat ends. If the steam pressure is 120 lb. per sq. in. find—

(*a*) The total pressure on the end of the boiler in tons;

(*b*) The circumferential tension per inch length of the cylindrical part.

3. A steel shaft 8 in. diameter and 12 ft. long supports a flywheel weighing 1½ ton, and revolves in bearings near each end.

(*a*) If steel weighs 0.28 lb. per cub. in., find the total load on the bearings.

(*b*) If the coefficient of friction between the shaft and the bearings is 0.02, find the total frictional force between the shaft and its bearings.

(*c*) If the shaft revolves at 3 R. P. M., find the H. P. absorbed by friction.

4. Make a simple sketch showing the arrangement of a single-purchase hand-winch having a velocity ration of 20, the barrel being 8 in. diameter.

What efficiency would you expect from this machine?

What load could be lifted by it when a constant tangential force of 40 lb. is exerted on the handle?

5. It is required to lift water at the rate of 200 gallons per minute through a vertical height of 150 ft.

Sketch the type of pump you would suggest, giving main dimensions.

If this pump has an efficiency of 70% how many H. P. will be necessary to drive it?

6. Define—Velocity ratio, mechanical advantage, and efficiency of a machine; Young's Modulus, stress, strain, shearing force, bending moment, elastic limit.

7. Give the formula for the moment of resistance of a circular shaft to twisting.

If a shaft transmits a twisting moment of 60,000 lb. in., what is its diameter if the stress is then 8,000 lb. per sq. in.?

If it revolves at the rate of 300 R. P. M., how many H. P. is it transmitting?

8. Deduce expressions for shearing force and bending moment on a cantilever beam—

(*a*) When supporting a uniformly distributed load;

(*b*) When supporting a concentrated load at the free end.

A cantilever of 12 in. ×12 in. hardwood projects 15 ft. from a wall.

If it weighs 70 lb. per cubic foot find the maximum stress due to bending.

If the maximum allowable stress is 2,000 lb. per sq. in., what is the greatest concentrated load that can be placed at the free end?

SOLUTIONS AND ANSWERS.

415. *From an entrance examination paper of Columbia University, submitted by G. J. Meredith, Jr., West New York, N. J.*

A boy has an electrical device whose resistance is 12 ohms and which requires a current of 2 amperes. The only source of current available is 120vD. C. and the only available resistances are 2 coils of 6 ohms and 16 ohms respectively. Show how these coils can be connected to give just the required current through the device.

Solution by S. P. Jenckes, Shortridge High School, Indianapolis, Ind.

The problem as stated is entirely correct, 2 amperes being obtainable, and also being the minimum current obtainable with the conditions and apparatus as stated in the problem.

Disregard the resistance of wiring, connections, etc.

With 6 ohms and 12 ohms in parallel, the equivalent resistance is

$$\frac{1}{\frac{1}{6}+\frac{1}{12}}$$ which equals 4 ohms.

With 4 ohms and 16 ohms in series we have their sum or 20 ohms as total equivalent resistance of the circuit.

120 volts can force 120/20 or 6 amperes through a circuit of 20 ohms.

This 6 amperes goes through the 16-ohms coil but splits between the 6-ohm coil and the 12-ohm apparatus inversely in proportion to their

resistance; or 4 amperes goes through the 6-ohm coil and 2 amperes goes through the 12-ohm apparatus, as required by the problem.

Additional solutions by Cornelius Murphy, Greenway High School, Coleraine, Minn.; O. E. Johnson, St. Paul, Minn.; Anonymous, Chicago, Ill. (correct).

These solutions are in addition to those published in the May, 1924, issue.

438. *Proposed by E. A. Rae, San Jose, Calif.*

An encyclopedia contains the following statement concerning the Nicholson hydrometer.

The weight of the instrument increased by the amount of weights added when the instrument was placed in water, divided by the weight of the instrument and the weights added when the instrument was in the liquid under test, will give the specific gravity.

Is this statement correct? If not, why?

Answer by Jas. A. Wilbur, Peoria, Ill.

The Nicholson hydrometer is of the constant volume type; weights always being added until it sinks to a certain mark on an extremely slender stem. Since the same volume is always displaced, and since the weight of the hyrdometer plus the sinking weights added must equal the weight of the liquid displaced. The more dense the liquid the more weights must be added.

The encyclopedia would be correct if it reversed its division, *specific gravity = wt. of substance ÷ wt. of equal volume of water.*

Wt. of water = wt. hydrometer + load when in water.

Wt. of solution = wt. hydrometer + load when in solution.

$$\text{Therefore sp. gr. of solution} = \frac{\text{wt. hydrometer + load when in solution}}{\text{wt. hydrometer + load when in water.}}$$

439. *Proposed by J. C. Packard, Brookline, Mass.*

At what rate can an auto be accelerated from rest? (In miles per hour per sec., or feet per sec.)

Trips abroad with college credit may be taken by students enrolled in the extension courses offered by the New York State Normal School at Buffalo. As a background for these trips a special course is offered in each of three subjects—European history, art appreciation, and English literature. Three European tours have been planned for next summer. They may take the English literature tour alone or the European history tour and art tours combined, or all three tours together. Credit for the work is given by the University of Buffalo.

Public-school health authorities supervise the health of boys and girls who work in the mills of New Bedford, Mass., and attend a continuation school one-half day a week, according to a statement issued by the Bureau of Education. These children receive health instruction at the continuation school and are weighed once a month. A group of these children were compared with an elementary-school group of similar age and educational qualifications, and it was found that as a rule the working child was less likely to be underweight than the school child. About 35 per cent of the school children were underweight and about 26 per cent of the working children. From this study, Dr. Hugh Grant Rowell, lecturer in physical education at Teachers College, Columbia University, concludes that the average child of 14 or 15 may work at a carefully selected job without harm, if the examining physicians perform their duties properly and the public health authorities co-operate with the continuation school in studying the children's physical condition and physical possibilities.

THE LITTLEST LIFE.

By Dr. Edwin E. Slosson

"How many angels can stand on the point of a pin?" was debated by the wise men of the Dark Ages. It was a good question for debate of the sort they delighted in because they never could find out, and if they could it would have made no difference to anybody.

"How many microbes can stand on the point of a pin?" is the question that interests the wise men of modern times, not for the fun of discussion, but because they can find out and because our lives depend upon their finding out.

For a single microbe may be more than a match for a man in single combat in spite of their disparity in size. Compared with this, the duel between David and Goliath was a fair fight on equal footing. The man, let us say, is five feet, ten inches tall. Against him we will put a microbe of moderate size, say a bacillus measuring only a micron in height. A micron is a millionth of a meter, or, if you prefer, a twenty-five thousandth of an inch. Such a microbe is not afraid to tackle a man, who is 1,750,000 times as tall and 5,000,000,000,000,000,000 times his fighting weight. Yet the microbe often succeeds in knocking him out.

For although the microbe has such odds against him on the start, they do not stay so. For the microbe grows faster than the man and is quicker at multiplication. The Asiatic cholera germ, for instance, doubles every fifteen minutes. If unlimited in space and food, its progeny would equal the mass of a man in the course of some fifteen hours. That is to say, a microbe that gets a lodgment in a man might eat him up in less than a day if the man were entirely edible and provided adequate accommodations.

To return to the point. I have just tried to measure the diameter of the point of a pin, but my desk rule is not fine enough, so I measured the head of it. It is not one of these new fashioned round-head pins, but the common metal kind, and its head is two millimeters arcoss, that is, two thousand microns. Now the bacillus of typhoid fever is two microns long and one wide. So that a thousand of them could be end to end across the pinhead or two thousand lying side by side.

But these are big ones compared with some. It was formerly supposed that water could be made germ-free by forcing it through a filter of unglazed earthenware, but it is now known that fifty distinct diseases are caused by germs so small that they will pass through the pores of porcelain. Among these are such well-known human diseases as influenza, smallpox, hydrophobia and measles, and a long list of plant diseases, especially those recognizable by mosaic discoloration of the leaves.

Most bacteria measure about a micron but the one that carries the flu infection, and is known as pneumosintes, may be only a tenth of that length. The chicken plague and the mosaic diseases of tobacco are carried by something still smaller, say a fortieth of a micron.

Now when the biologist gets down as fine as this he comes into conflict with the chemist. For a single molecule of hemáglobin, the red coloring matter of the blood, is bigger than one of these creatures—if they are creatures. If they are not, how is it that they can grow and multiply and carry their specific characteristics over from one animal or plant to another? But if they are living organisms they must be largely composed of protein and the protein molecule is so large that the chemist can only allow the biologist a few hundred or at most a few thousand molecules out of which to construct the necessarily somewhat complicated machinery of these virulent bodies.

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But in spite of the criticism of the chemist the biologist continues to discover minuter bodies which possess some of the functions of life. Bacteria are found to be devoured by something that d'Herelle of the Pasteur Institute calls "bacteria eaters," or if you insist upon the Greek of it, "bacteriophages." These also are filter-passers and must be much smaller than the bacteria on which they prey, but whether they belong to the realm of chemistry or biology is still in dispute. Possibly the question may be settled in the end by finding that there is no definite dividing line between the two realms.—*Science Service.*

NON-BOILING STEAM GENERATOR DOUBLES EFFICIENCY.

A new steam generator, revolutionizing former conceptions of steam engineering, has been given a successful trial at Rugby, England. It is capable of producing power from coal at an overall efficiency of something like 28 to 30 per cent. This approaches the efficiency of the Diesel oil-burning engine, which is about 35 per cent, and is in contrast to 17 to 18 per cent. efficiency for the most modern superpower station at 350 pounds pressure and 700 degrees Fahrenheit superheat. Its efficiency rivals that of the new mercury vapor boiler recently developed in America.

The generator is the invention of M. Benson of the Benson Engineering Company of London. Its principle is the production of steam at a pressure of 3200 lbs. per square inch, and at the "critical temperature" of water, 706 degrees Fahrenheit. This is by far the highest pressure ever used in steam production.

The "critical temperature" of any liquid is the temperature above which it no longer can exist as a liquid, no matter how high the pressure. Above that point the whole of the liquid changes suddenly and completely into a gas without alteration of volume. The phenomenon can be observed in a laboratory using liquid carbon dioxide, from which soda water is made, sealed in a thick glass tube and heating it slowly to 89 degrees Fahrenheit, when the whole of the liquid suddenly changes into gas. The application of this principle to water is the basis of the Benson generator, which is described by "Chemistry and Industry" here as follows:

"In the 'Benson' generator water is converted into steam at the critical temperature of 706 degrees Fahrenheit, that is, the whole mass of the water in the coils is bodily changed into steam at the same volume without the absorption of any latent heat, since the volume remains the same. It will be obvious that as no latent heat is absorbed, there is no ebullition or 'boiling,' that is, the sudden conversion of small particles of water into comparatively large bubbles of steam, the energy required for this increase in volume constituting the latent, or lost heat.

"It is on these highly ingenious lines that the essential trouble of the small-bore coil steam-generator has been overcome, the fact that because of the absorption of latent heat and consequent boiling the water will not remain in contact with the sides of the tube, and the generation of steam is spasmodic and apt to be explosive. The generation of steam at the critical temperature has, of course, completely eliminated this difficulty so that narrow-bore steel coils can be used which will withstand almost any pressure; in fact, the present installation is said to have been tested hydraulically to 6400 lb. pressure.

"The actual installation at Rugby, which is only one of a number of different arrangements possible, consists of generator coils of 3-4 in. steel tube, 1-4 in. thick, placed to a height of 8 ft. round an inner vertical cylinder of fire-brick. This is surrounded by an outer casing and a superheater, consisting of similar coils, is placed on the top. Distilled water

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is passed in continuously at the bottom of the coil by means of a motor-driven hydraulic force pump working at 3200 lb. pressure, the evaporation on the trials being about 8000 lb. per hour, although 10,000 lb. is the normal figure and is easily obtained. The installation is heated from the bottom by means of an oil blast flame with heated air. Pulverized fuel or gas would do equally well.

"The water as it travels upwards through the coil is gradually raised to a higher and higher temperature, until when 90 per cent. of the total length has been traversed the critical temperature of steam, 706 degrees Fahrenheit, is attained, the pressure being, of course, all the time 3200 lb. At this point the whole mass of the water in the coil, three times the volume when at 60 degrees is bodily and quietly converted into steam at the same volume without the absorption of latent heat and without boiling.

"For the remainder of the travel in the coil the steam is then very slightly superheated to 720 degrees and subsequently passed through a reducing valve, during which the temperature is lowered to 620 degrees and into the superheater, being finally discharged from the latter at 1500 lb. pressure, and 850 degrees Fahrenheit. It will then be used in a small high-pressure turbine, running at 20,000 to 25,000 revolutions per minute, exhausting at 200 lb., generating 350 kilowatts in the process, into an ordinary condensing turbine, giving a further 900 kilowatts down to a 29 inch vacuum.

"The enormous economy to be obtained by working at 1500 pounds and 850 degrees will be apparent. Further details will be awaited with interest as the work unquestionably represents a complete revolution in steam practice."—*Science Service.*

BETELGEUZE, ERRATIC GIANT OF THE HEAVENS.

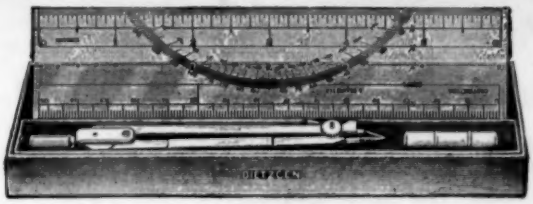
By Isabel M. Lewis,

U. S. Naval Observatory.

No star in the heavens has been more before the public eye in the past few years than ruddy Betelgeuze in Orion which now shines so brilliantly in the southwest in the early evening. Betelgeuze leaped into fame in the winter of 1920 when, chosen as the object of the first test in measuring the diameters of the stars with the Michelson interferometer attached to the 100 inch telescope of the Mt. Wilson Observatory, it was found to have a diameter of over two hundred million miles.

Betelgeuze is not only a giant, however. It is a most erratic giant. Later measurements with the interferometer showed variations in its diameter such as have not been found in the measurements of the diameters of other giant stars with the same instrument. This fact taken in connection with the fact that Betelgeuze has long been known as a star that varies irregularly in brightness makes it appear that it is irregularly contracting and expanding in size, pulsating, like some mighty heart of the heavens. The brightness apparently increases with contraction and decreases with expansion of the star.

Betelgeuze is now at its maximum brightness. It is more brilliant than Rigel, the bluish-white star in Orion diagonally opposite to it, toward the southwest, and it has been rivalling and at times surpassing Capella, the beautiful golden star in Auriga to the northwest of it. It is also much brighter at the present time than it was a year ago. When at its minimum brightness it is decidedly inferior to Aldebaran which is in the V of the Hyades in Taurus to the northwest of Orion and which to the ancients



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represented the baleful, red eye of Taurus, the Bull. At maximum brightness Betelgeuze is over three and a half times more brilliant than it is at minimum brightness and the change may take place within a year or less.

Aside from the fact that the diameter of the star is changing continually as a result of its irregular contraction and expansion, there is an additional uncertainty as to the actual size of Betelgeuze which results from the uncertainty as to its distance. To change the angular diameter, that is given by the interferometer, into miles, it is necessary to know the parallax of the star which is simply the angular distance between earth and sun as viewed from the star. This value can be obtained in a variety of ways. According to the latest report from the Mt. Wilson Observatory, the best value of the parallax of Betelgeuze is seventeen thousandths of a second of arc. That is how far apart in angular measure the earth and sun would be at the distance of Betelgeuze. This value gives 190 light years as the distance of Betelgeuze from the earth and a diameter for the star of 245,000,000 miles.

Very recently the parallaxes of over one thousand stars have been determined at the Dominion Astrophysical Observatory at Victoria, B. C., with the 60 inch reflector by the spectroscopic method, and in this list we find for Betelgeuee a parallax of one hundredth of a second of arc, which would place Betelguze at a distance of about 325 light years and give the star a diameter of over 400,000,000 miles. It is possible, then, that Betelgeuze may be even larger and more distant than earlier estimates have made it. It is probable that its size has been underestimated rather than overestimated, and it may elosely rival if not surpass Antares, which is estimated to have a diameter of about 400,000,000 miles.

With the value of the parallax found at the Dominion Astrophysical Observatory, the actual brightness of Betelgeuze comes out about five thousand times that of the sun. If the sun and Betelgeuze were placed side by side at a distance of thirty-three light years from the earth, the sun would appear as a faint star of the fifth magnitude, but Betelgeuze would be as brilliant as Venus as it now appears in the western heavens. —*Science Service*

LYMAN C. NEWELL.

Professor Lyman C. Newell, head of the Department of Chemistry in Boston University, delivered an address on "The Earlier and Later Days of Chemistry in New England" at the twenty-fifth anniversary meeting of the New England Association of Chemistry Teachers, held March 15, in Malden, Mass., where the organization was founded. The address was illustrated with lantern slides, portraits, and autograph letters from Dr. Newell's collection. In recognition of his services to the Association Dr. Newell was presented with a copy of resolutions adopted at this meeting. The resolutions acknowledge the work which Dr. Newell has done for the society and express the thanks of the organization for his unbroken services in many ways. Dr. Newell was a moving spirit in the formation of the Association. He was its first president and now holds the office of Curator of the library and museum.

Attack on the Oregon law requiring attendance at public schools has been made in the form of an application for injunction brought by Hill Military Academy, of Portland, against Oregon state officers to prevent them from executing the law. The application was argued in the Federal court at Portland, and decision was taken under advisement. The law is scheduled to become effective September 1, 1926.

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NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS.

The National Council of Teachers of Mathematics held its annua meeting in conjunction with the Department of Superintendents of the National Education Association in Chicago on February 23, 1924. The following papers were presented: "A Better Use of Tests," by W. D. Reeve of Teachers College, Columbia University; "Memory and Mark,. in Mathematics," by Ethel Luccock, Northwestern High School, Detroits Michigan; "The Laboratory Method in the Class Room," by Charles Stone, University of Chicago High School. At the banquet in the evening, with Professor H. E. Slaught presiding, the following papers were read: "Reliability of Teachers' Marks," by Raleigh Schorling, University of Michigan High School, Ann Arbor, Michigan; "Teaching Pupils the Conscious Use of the Technique of Thinking," by Elsie P. Johnson, Oak Park High School, Oak Park, Illinois.

DUMMY DONKEY FOOLS TSETSE FLY.

Dummy donkeys with sticky legs are proposed for experiments in destroying large numbers of tsetse flies, which carry the germs of the African sleeping-sickness, in a publication of the Department of Agriculture of South Africa.

R. H. Harris found that these dangerous insects were attracted to the legs of his donkey. He built a dummy animal with wooden legs covered with old bags, but the flies apparently did not discriminate between the natural and artificial limbs. He suggests construction of many such dummies covered with sticky materials to destroy the insects by the wholesale.—[*Science Service*.

All girls who enter the high school of Oswego, N. Y., are required to take a course of ten weeks in home nursing. The superintendent of the Oswego hospital is the instructor.

To enable British architects to study in the Uinted States, a six-month scholarship has been founded by an American architect. The winner of this scholarship will study especially the development of the apartment house.

Lantern slides on health subjects are lent to schools and other organizations by Montana's State Department of Health. Among the subjects of slides are conservation of vision, good teeth, care of the baby, and school hygiene.

Classes in art for selected elementary-school pupils of all grades are offered on Saturdays by the Milwaukee Art Institute. Each school is entitled to eight representatives in these classes, three from the first six grades and five from the seventh and eighth grades.

ERRATUM

The following was inadvertently omitted from the bottom of page 486, May, 1924.:

They sought for the cause of his spirit morose,
They offered him candy, they patted his head,
They coaxed and they counseled, they threatened and plead.
"Be a *man*, son, said dad, and when that word was said
Tim burst; "Yes, I will, when you folks are all dead!
Then I'll be a man, for I'll wear my own clothes!"

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LIBRARIES: ANCIENT FACTORS IN MAN'S DEVELOPMENT.

"Remembering that the art of printing on paper is not very old, we are likely to look upon libraries, those potent instruments for the spread of knowledge, as relatively modern things," says a bulletin from the Washington, D. C., headquarters of the National Geographic Society. "True, the movement to get the greatest amount of literature into the hands of the most people is just getting well under way in many countries; but true libraries existed for thousands of years before the birth of Christ, and they have constantly commanded the interest of king, priest and layman ever since.

"Four thousand years ago the firm of Murashu Sons, bankers and brokers at Nippur, Assyria, comparable in their status in that country to the Rothschilds in England and the house of Morgan in the United States, stacked in their business archives clay tablets written before the era of Abraham which recorded hundreds of their transactions.

Nineveh's Libraries had "Shelf Numbers."

"Ashurbanipal who died in 626 B. C. had at Nineveh a library which had been classified and arranged according to the subject matter of the tablets, each series being given a number and a title, composed as a general rule of the first words of the first tablet. The king sent out his scribes to all the temples and schools of Babylonia and Assyria and had them make copies of tablets in the then modern Assyrian language. The story of the Deluge now in the J. Pierpont Morgan library in New York City, which is dated about 2000 B. C., is clearly a copy of an older version.

"The Egyptians, too, had their libraries. Behind the hall of columns of the Rameseion at Thebes, was the Sacred Library called the 'Dispensary of the Mind.' It had an astronomical ceiling on which the twelve Egyptian months were represented and its walls showed a procession of priests carrying the sacred arks. Its circle of 365 cubits, each representing a day of the year, was carried off by the Persians and is therefore lost to us except through the description of Diodorus.

Greeks had Greatest Early Libraries.

"The Greeks probably had a few private libraries during the fifth and fourth centuries B. C., but we practically now know nothing of their character. But to the later history of the Greeks are accredited two of the greatest of the ancient libraries of the world. The first of the Ptolemies collected the twin libraries at Alexandria containing 700,000 volumes carefully arranged and catalogued, which were burned when Julius Caesar set fire to the shipping in the harbor. The great library of Pergamum in Asia Minor, which Plutarch says contained 200,000 volumes, was ultimately sent to Alexandria as a gift to Cleopatra from Antony, with the view to making good in some measure the loss which had been caused by Caesar.

"The Athenians had become book-lovers by the time of the invasion of the Goths, for it is related that one of the Gothic chiefs, on finding some of his soldiers on the point of burning the libraries of Athens, told them to leave the books to the effeminate Greeks, as the hands accustomed to the smooth papyrus would feebly grasp the arms of the warrior.

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"Though Rome was slow to develop an interest in literature and her first libraries were those which she took as spoils of war, by Imperial times the library facilities of the city were far ahead of those of modern Europe before the middle of the eighteenth century.

FAMOUS CONSTANTINOPLE LIBRARY SPREAD THROUGH EUROPE.

"Constantine the Great, in 336 B. C., founded a library at Constantinople which grew under his successors until it contained one or two hundred thousand volumes, among the more valuable manuscripts being the only authentic account of the proceedings of the Council of Nice and a manuscript of Homer written in letters of gold on serpents' skin which measured 120 feet in length. Although several fires played havoc with the collection, from this library have some of the choicest treasures now to be found in the libraries of Europe.

"Another library which lost some of its treasures to thirty of the great libraries of Europe and others in oblivion was the famed Corvina, collected by the witty, attractive, and scholarly Matthias Corvinus, King of Hungary, in 1460. This collection of more than 50,000 manuscripts, probably the largest and finest of its kind ever made in Europe, was the hobby of a monarch of taste and discrimination. But the Turks in 1527 rifled the rich halls it occupied in the castle of Buda and scattered its precious contents over the continent.

FRANCE HAS GREATEST MODERN BOOK COLLECTION.

"Among present day libraries the Bibliotheque Nationale, at Paris, with its more than 5,000,000 printed books, 500,000 maps, 110,000 manuscripts, and over 1,000,000 prints, easily outranks all others.

"The British Museum Library claims second honors for size and an even score with its rival on the value of its contents.

"The Library of Congress, at Washington, with its more than 3,000,000 volumes, stands third upon the list of the world's great libraries.

"But there are almost as many libraries of peculiar kinds as there are races of men. The Arab libraries, consisting for the most part of works on theology, jurisprudence, and philology are attached to their mosques, are seldom read and rapidly fall into decay. The leaves of the books are not often bound together, but usually are placed loose in a leather or pasteboard cover, so that several persons can use the same book at the same time, each taking out a handful of leaves. The Buddhist writings in the temples of eastern Tibet are printed from blocks such as were first used in China, or are written by hand. The Buddhist scripture of Siam were written by some devotee with brass or iron stiles upon the leaves of the Talipot palm,

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The "dog car" is an Alaskan invention. An abandoned railroad runs out of Nome to a mining camp. The enterprising Arctic Circle mailman hitches his dog team to a hand car and scoots up the mountain side with the post.

Last year the air mail planes flew 2,000,000 miles, carrying 65,295,920 letters.

Although interstellar service has not yet been established by the Post Office Department, it is a fact the routes covered by the railway mail cars last year reached the planetary proportions of 219,171,224 miles. This transportation cost $85,194,239. The Postal Service now uses 5,096 postal cars.

Automobiles are running a race for numerical supremacy with the railway postal cars. There are now 4,930 in operation carrying the mails.

The biggest single business operates through postal savings, the biggest savings bank in the world. Its total deposits in 1923 were $134,458,105.29. The United States Government stands back of this bank.

The American people make good use of the money-order system, too. In 1923, the amount of money sent by money orders was $1,376,000,000. There were more than 172,000,000 orders issued.

These figures do not include the funds sent abroad by international money orders, which totaled $34,118,000. At the same time $19,255,000 in money orders issued abroad were paid in the United States.

Then there is registered, insured, and C. O. D. mail. People are anxious that certain mail be given every protection. There were 88,741,000 articles registered last year.

Insurance against loss was given to 140,545,000 pieces of mail last year, while 40,427,000 were sent with the well-known mark, C. O. D.

Buffalo (N. Y.) evening schools offer the public whatever educational service it demands, and any course requested by 15 persons will be provided. During the past school year these schools enrolled 22,424 persons, one out of every 15 in the population more than 16 years old. More than half of the registrants continued to attend regularly throughout the year.

The annual meeting of the National Congress of Mothers and Parent Teacher Associations will be held during the week of May 5, at St. Paul, Minn. The president of the organization, Mrs. Augustus Reeve, of Philadelphia, has arranged a program covering all phases of child welfare.

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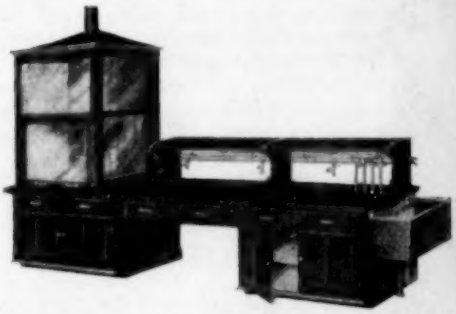

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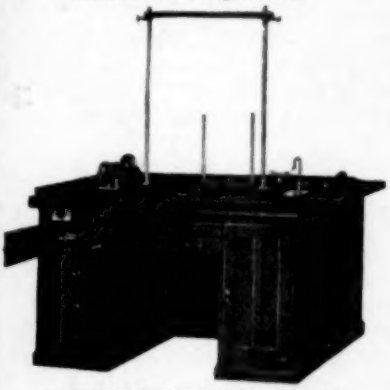

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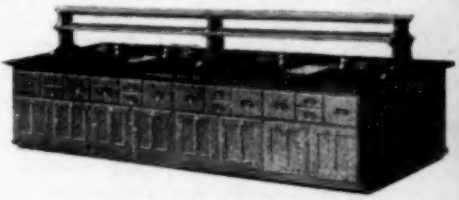

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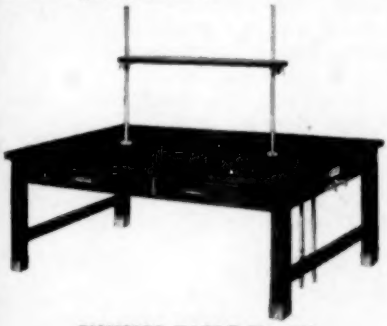

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This is the conclusion of Prof. Archibald Henderson, of the University of North Carolina, given in a communication in the September 8 issue of "Science." He assumed that space and the universe are constructed according to Einstein's general relativity theory.

"It would take a ray of light, traveling at the rate of 186,000 miles per second, one billion years to go around the universe," Professor Henderson says. "To go around the universe it would take the fastest aeroplane three quadrillion years; the fastest automobile five and one half quadrillion years; and an express train, traveling at the rate of sixty miles an hour, eleven quadrillion years.

"If it is assumed that the average density of matter in the universe is the same as that of the Milky Way, the radius of the universe is at least 150 million light-years; or since the distance from the earth to the sun is 93,000,000 miles, the radius of the universe is one million times ten million times the distance from the earth to the sun. The weight of the universe in grammes would be one, followed by fifty-four ciphers, which would carry us into the nonillions of grammes.

"The weight of the Einstein universe bears the same relation to the weight of the whole earth as the latter bears to a kilogram. The weight of the earth to that of the sun is as one to 324,000. Hence we should have to take a trillion suns to get the weight of the universe."

Space, according to Einstein, has seemingly queer properties, Professor Henderson says:

"Einstein has advanced the view that the universe is finite, but unbounded. This statement sounds paradoxical, but brief reflection will show that a thing may be unbounded without being infinite. A being which moves on the surface of the earth, or indeed of any sphere, may travel over it indefinitely without ever reaching any boundary or limit. Similar considerations, extended to three-dimensional curved space, enable us to see how the universe may be at the same time finite and unbounded. Assuming further the existence of pressure inside the electrically charged particles of matter in the universe, Einstein showed by elaborate calculations based on general relativity that space is 'spherical' in structure.

"This 'spherical' space is curved space—which means that according to Einstein the geometry of our universe is not Euclidean. The universe, moreover, does not have the shape of a sphere. It is not a three-dimensional space cut out of four-dimensional space—as is a sphere a two-dimensional space cut out of a three-dimensional space. It possesses the following properties: All lines starting from a point intersect again in the antipodal point measured along any of these lines. If a stellar body move through spherical space, its size gradually increases until it reaches its maximum at the universe's outer verge; and there, as it were, reentering the universe it gradually diminishes in dimensions until it ultimately reaches its original size and position. Every point stands in the same relation to the rest of space as does every other point. There is no boundary to spherical space, and no center."

Professor Henderson says that the question: "What lies beyond?" has no meaning for Einstein because the foundation of general relativity is the doctrine that there is no space without matter or energy. If all the

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heavenly bodies we know belong to our galactic system. it is possible, according to Einstein, that other universes exist independently of our own. They may remain forever optically isolated from us by the phenomenon of the cosmic absorption of light.

"We are doomed to dwell within a finite universe a thousand million times greater than the region now accessible to astronomical observation," Professor Henderson says. "While other universes may palpitate beyond our own, no ray of knowledge could ever reach us from them."—[*Science Service.*

CHILD HEALTH.

Dr. Borden S. Veeder, Professor of the Clinic of Pediatrics, Washington University, St. Louis, Missouri, is chairman of the program committee for the American Child Health Association annual meeting. Members of Dr. Veeder's committee are: Miss Sara B. Place, R. N., Superintendent of Infant Welfare Society, Chicago, Ill.; Miss Maude A. Brown, director of Health Education of the Child Health Demonstration, Fargo, N. D., and Dr. S. Josephine Baker, consulting director in maternity and infancy and child hygiene of the Children's Bureau of the United States Department of Labor. Dr. Baker is known as one of the foremost authorities in the nation in the field of child health. Her resignation last spring from the position of director of the Bureau of Child Hygiene of the New York City Department of Health came after twenty years of pioneer work for the welfare of mothers and babies.

Dr. Frank C. Neff of the Kansas City Pediatric Society is local chairman of arrangements for the convention and he is being assisted by a committee of citizens representing local organizations. The meeting in Kansas City will bring together the lay members of the American Child Health Association and an eminent group of physicians, nurses, public health specialists, deans of medical and dental colleges of the leading universities of the country, nationally known educators, nutritionists, biologists and specialists in various scientific fields onnected with child health investigation.

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We believe that one who aspires to be a leader of youth should have, first of all, character—that subtle and indefinable quality which is finer than the finest deeds; greater than the greatest facts, which includes, but transcends, honor—a nice sense of what is right, just, and true, with a course of life corresponding thereto;

Vision—a supreme faith in the ultimate triumph of the ideal good;

Patience—which means the ability and the willingness to wait, and may also mean kindliness to evil-doers, and bearing with the weaknesses of others;

Justice—recognizing in our fellow-man another self—seeing both sides of every question;

Benevolence—that which helps another to help himself—not indulgence;

That energy and enthusiasm which can be satisfied only by seeing ambition realized;

Service—"The power to give the world more than I take."

And with these a broad education, both liberal and professional, as a preparation for one's life work, so that he may do it conscientiously and with pleasure because he can do it well.

"And it came to pass that after awhile the artist was forgotten—but the work lived."—*N. S. C.*

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BOOKS RECEIVED.

Economics, by Eugene B. Riley, Bushwick High School, Brooklyn, New York, pages 103, 12.5x19 cm., paper, 1924, Globe Book Company, New York.

Arithmetical Essentials, the Teaching Manual, Part I, third and fourth grades, by J. A. Drushel, Teachers College, St. Louis, Margaret E. Noonan, Teachers College, Columbia University, and John W. Withers, New York University, New York, pages 104, 13.5x19 cm., cloth, 1924, Lyons & Carnahan, Chicago.

Law and Freedom in School, by George A. Coe, Columbia University, pages ix+133, 13x19.5 cm., cloth, 1924, University of Chicago Press, Chicago.

Arithmetical Essentials, Book I, by J. A. Drushel, Teachers College, St. Louis, Margaret E. Noonan, Teachers College, Columbia University, and John W. Withers, New York University, New York. Pages xv+304. 13x18.5 cm., cloth, 1924, 72c. Lyons & Carnahan, Chicago.

Makers of Science, Mathematics, Physics, and Astronomy, by Ivor B. Hart. Pages 320. 13x19.5 cm. Cloth, 1924. $2.00. Oxford University Press, London.

The Unstable Child, by Florence Mateer, Mental Hygiene School, Columbus, Ohio. Pages xii+471. 13.5x19 cm. Cloth, 1924. D. Appelton & Company, New York.

Guide to Literature of Home and Family Life, by Annie I. Robertson, Hartford High School. Pages xv+284. 16x24 cm. Cloth, 1924. J. B. Lippincott Company, Chicago.

Northern Woodlot Trees, by James B. Berry, Penn. State Department of Education. Pages x+214. 14x19.5 cm. Cloth, 1924. $1.20. World Book Co., 2126 Prairie Ave., Chicago.

An Introduction to Safety Education, by the National Safety Council. 93 pages. 15x23 cm. Paper, 1924. 30 cents. 168 N. Michigan Ave., Chicago, Ill.

The Community and Its High School, by Paul E. Belting, University of Illinois. Pages vi+371. 14x19 cm. Cloth, 1924. D. C. Heath & Co., Chicago..

Modern Mathematics, seventh, eighth and ninth school year, by Raleigh Scharling, University of Michigan and John R. Clark, Lincoln School, Columbia University. Pages xiv+256. 14x19. Cloth, 1924. World Book Co. Yonkers, New York.

First Course in Algebra, by Joseph E. Nyberg, Hyde Park High School, Chicago. Pages 336+xxvii. 13x19 cm. Cloth, 1924. American Book Company, Chicago.

Teaching First Year Chemistry, by J. O. Frank, Normal School, Oshkosh, Wis. Pages 67. 15x23 cm. Paper, 1924. $1.00. J. O. Frank, Oshkosh, Wis.

College Algebra, by Lewis P. Sceloff and David E. Smith. Pages iv+258. 13.5x19 cm. Cloth, 1924. $1.80. Ginn & Co., Chicago.

Farm Woodlands, by James B. Berry, Vocational Supervisor State of Pennsylvania. Pages vi+425. 14x19 cm. Cloth, 1924. $2.00. World Book Company, Yonkers, New York.

Elements of General Science, by Otis W. Caldwell, Director of Lincoln School, Columbia University, and William L. Eikenberry, Normal School, East Stroudsburg, Pa. Pages xiii+455. 14x20 cm. Cloth, 1924. $1.60. Ginn and Company, Chicago.

Modern Algebra, eihth school year, by Raleigh Schorling, University of Michigan, and John R. Clark, Lincoln School. Pages xvii+254.

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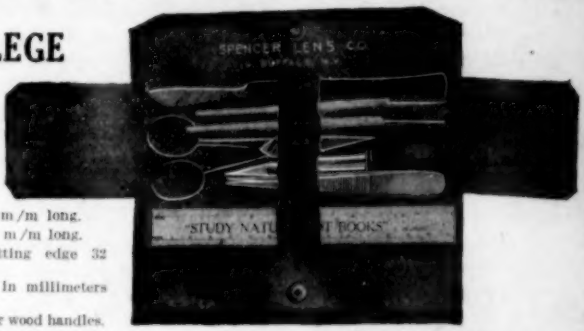

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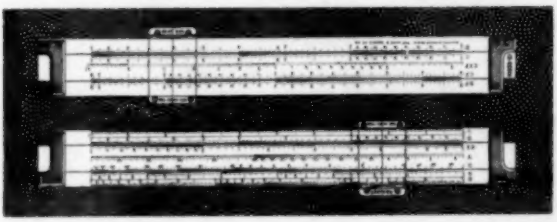

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14x19 cm. Cloth, 1924. 88 cents. World Book Co., Yonkers, New York.

Modern Algebra, ninth school year, by Raleigh Schorling, University of Michigan and John R. Clark, Lincoln School. Pages xiii+382. 14x19 cm. Cloth, 1924. $1.36. World Book Co., Yonkers, New York.

Reference Studies in Medieval History, in three parts, by James W. Thompson, University of Chicago. Pages xxxvi+xii+xi+342. 13x20 cm. Paper, 1924. University of Chicago Press, Chicago.

SAFETY TEACHING IN OUR SCHOOLS.

Whatever may be our general attitude toward using the schools for the teaching of such subjects as safety we must admit that a situation exists at present which the schools cannot disregard. With 20,000 children of school age being killed by accident each year, with 15,000 people being killed by automobiles each year, a number that is rapidly growing, with a fire loss measured in 14,000 lives and three hundred million dollars of property destroyed, the school must come to the rescue in helping to solve a problem which has proved too much for the home, unaided, and particularly since actual experience in the schools themselves shows that a 50 per cent saving in lives can be had, that is a saving of the lives of 10,000 schools children each year.

In the first place, nothing can be more important in a child's life than an adequate conception of the world as a place that is ordered or subject to order and of life as a purposeful thing. This must be the basis for all effective cultural development and the basis particuarly for law and ethics and religion.

The degree of passionate interest that children display in this work is a matter for perpetual astonishment; it comes to them in the nature of a crusade and is an outlet for the kind of emotion that goes into patriotism and kindred sentiments. This shows how close it lies to the heart of life and also, perhaps, how the sense of tragedy in physicial accident has not yet been dulled by a sense that comes later of the still greater tragedies that are implicit in life.

The key to the problem is unquestionably education. The main features of the teaching technique have been developed and have been in operation in enough schools a sufficient length of time to show that the plan has been worked out along essentially right lines.

While there is much still to be done in the development of detail and perhaps of fundamental principles and in checking all this up, the pre-eminent need today is the actual getting of the work into the schools. The National Safety Council is solving this problem by encouraging the formation of what we call demonstration centers. A demonstration center is a school that is not only willing to put in safety education, or it may be one that has already had it in operation, but it agrees to prepare a special demonstration on a given date for the benefit of other schools in the region, and to be ready from time to time as the need may arise to show how the work is done.

Last year during only a limited part of the school term, eleven such demonstration centers were organized; these reached about 1600 teachers outside of the schools that acted as demonstration centers. This year with a field secretary giving her whole time to this work we expect to make rapid progress and it should be a matter of only a few years before the United States will from this point of view be pretty well organized; it will, that is, be possible for any school that desires to put in the work to visit some school in the vicinity where the work is being carried on.—*National Safety Council.*

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A row of business buildings in Pittsfield, Mass., are now heated by the exhaust steam from a 750 kilowatt turbo-generator used by a local power company, says the Engineering News-Record in its current issue.

The steam is conducted to the generator through what is believed to be the longest high-pressure steam line in the world. It is 3,600 feet long, carries the steam at a pressure of 195 pounds, and is built partly under and partly above the ground. The pipe is eight inches in diameter and covered by three inches of insulation, consisting of two quarter-inch layers of fireproof felt over which is a layer of eight-five per cent magnesia; over this is a protective jacket of heavy duck, while, to waterproof the whole, a three-ply wrapping of roofing paper is used.

BOOK REVIEWS.

Carnegie Foundation for the Advancement of Teaching Eighteenth Annual Report and the President. xvi+166 pages, 19x25.5 cm., Paper, 1924. 522 Fifth Ave., New York City.

This is a complete report of the president and treasurer of this foundation for the past year. It gives the income and expenditure in splendid form. It, also, gives the activities of the foundation so that the reader may know what it is endeavoring to do in order to help humanity. The question of teachers' needs is discussed in all of its phases. The discussion of the action of colleges and universities, and the establishment of old age annities is taken care of in splendid shape. Extensive discussion is made of the educational part of the foundation with reference to the various schools which have been assisted by the foundation. The responsibility for all educational integrity is discussed quite fully. They discuss the relation of instructors with the various kinds of schools. Teachers' pensions are taken care of in splendid shape, various states being mentioned in this direction. A list of the men who have recently died is given also with the little biographical sketch. A report of the treasurer with list of investment, etc., is given. A long and complete list of ten pages is given in the index. All people interested in the Carnegie Foundation should possess themselves of a copy of this report.

C. H. S.

The Community and Its High Schools, by Paul E. Belting, University of Illinois, Pages 371. 14x19 cm. Cloth, 1923. D. C. Heath & Company, Chicago, Ill.

This book is intended, primarily, for students of education and teachers who are unfamiliar with the best ways of imparting the knowledge which they may possess to other pupils. Chapter one deals with the important principles which have made an important bearing upon the present method of education. Much of the third chapter has to deal with the manner in which the high schools of the community may act as a medium for imparting knowledge which will train the young to the highest type of citizenship. The latter part of the book is devoted more especially to pure secondary education. Without question it is one of the leading books of this nature that has recently come from the press. Each chapter closes with a pertinent list of questions bearing upon that chapter as well as a very complete bibliographey. It is printed on uncalendered paper, thus removing the disagreeable feature of reflected light. It is well indexed, splendidly written, and interesting to all school men and others as well. It is a book that should be in the hands of every up-to-date and progressive person interested in the instruction of the young.

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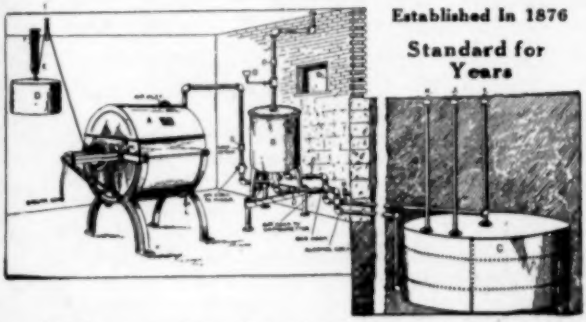

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Makers of Science, Mathematics, Physics, and Astronomy, by Ivor B. Hart, Pages 320. 13x19.5 cm. Cloth, 1924. $2.00. Oxford University Press, London.

A book which gives a short account of the makers of science from Aristotle to Lord Keldin. It is an interesting book, splendidly written and illustrated. Any one wishing to know the epitome of the high points in science for the time mentioned, cannot do better than to study this book. C. H. S.

An Introduction to Safety Education, by the National Safety Council. 93 pages. 15x23 cm. Paper, 1924. 30c. National Safety Council, 168 North Michigan Ave., Chicago.

This is a splendid condensation of the pitfalls which surround all of us, with reference to our inability, apparently, to keep from being injured in one form or another. This is largely due to the fact that we have not been educated sufficiently to be on the alert at all times against accidents of many kinds, also, for the reason that we have not been eduated enough to understand the care that we should take of our bodies when they do suffer an injury.

The National Safety Council is doing pioneer work in spreading the gospel of accident prevention. It is an admirable book, splendidly written, diction is fine, and altogether it is a book that ought to be in the hands of every individual. C. H. S.

Economics, by Eugene B. Riley, Bushwick High School, Brooklyn, New York. Pages 103. 12.5x19 cm. Paper, 1924. Globe Book Company, New York.

This little outline has been prepared chiefly to present the fundamentals of economics in a brief and contrite manner. It presents outline at the time of study. At the end of each project there is a list of pertinent questions. A list of valuable recent examinations is given at the end of the book. Teachers of economics are advised to secure a copy of the book. C. H. S.

Law and Freedom in the School, by George A. Coe, Columbia University. Pages ix+133. 13x19.5 cm. Cloth, 1924. University of Chicago Press, Chicago.

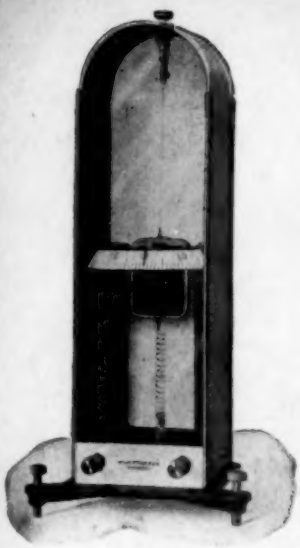
A book prepared for every one intensively interested in schools to become more familiar with that part of school work which is not commonly manifesting itself at the surface. Contact with this book will, without question, cause the reader to become more sympathetic, not only toward the pupil, but the teacher as well. A book that all people interested in the betterment of the schools should secure and read.

C. H. S.

The Unstable Child, by Florence Mateer, Mental Hygiene School, Columbus, Ohio. Pages xii+471. 13.5x19 cm. Cloth, 1924. D. Appelton & Company, New York.

When one begins to study the child, as he should be studied by intelligent people, in all of its various functioning phases, he is bewildered with a great mass of literature bearing upon the subject. The latest of these books is one of the best from which to secure helpful information concerning all phases of a child's life. This is especially true with delinquent and troublesome children. The book is printed on the uncalendered paper in the ten point type, is cleverly written, and makes interesting reading even to the ordinary layman. There are many footnotes to outside reading. Five pages of bibliography are given. It is well indexed, and is a book that should, and doubtless will have large sales.

C. H. S.



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Guide to Literature of Home and Family Life, by Annie I. Robertson, Hartford High School. Pages xv+284. 16x24 cm. Cloth, 1924. J. B. Lippincott Company, Chicago.

This book has been compiled for the purpose of bringing together a list of books and other information which will enable the householder or any one interested in the affairs of the home in any phases, to secure that book or literature that will enable him to become familiar with that particular topic for which he is seeking information. No matter what the line of work may be, this book is a complete bibliography. The author does not stop with over 200 pages of books, but in the appendix there is a guide to various publishers, and a list of magazines appertaining to anything connected with the household. A complete index of authors is given, as well as an index of subjects. It is a book that every library should possess. C. H. S.

Northern Woodlot Trees, by James Berthold Berry, M. S., County Vocational Supervisor, Pennsylvania. A guide to the identification of trees and woods for students, farmers and woodsmen. Cloth 13x18.5 cm. Pages x+214, illustrated with 105 figures from drawings and photographs. Published by the World Book Company, 1924, price $1.20. This is one of the "New World Agriculture Series" of books, edited by W. J. Spillman. It is designed to accompany "Farm Woodlawns," a handbook of trees and woods by the same author.

The execution of the book by both author and publisher is very fine. The book has been written, evidently, rather for the practical woodsman and farmer, than for the student, thus the subject matter is treated in a somewhat different manner than is usual in "treebooks." We like the book—the information is concise and to the point—just what a student woodsman or farmer would want to know in regard to the identification and characteristics of woodlot trees and woods. W. W.

First Course in Algebra, by Joseph A. Nyberg, Hyde Park High School, Chicago. Pages 336+xxvii. 13x19 cm. Cloth, 1924. $1.24. American Book Company, Chicago.

Those of us who have dealings with pupils grouped into C sections are interested in a book in which "the wayfarer though a fool may read!" This is what Nyberg has tried to do in his "First Course in Algebra." He has attempted to do away with obsolete expression and bring the definitions down to date. However, the chapters do not begin with cumbrous definitions. The terminology comes *after* the pupil can appreciate because he needs it to express his ideas. This terminology is based on the recommendations of the "National Committee of Mathematical Requirements."

New departures in this book include an early treatment of fractional equations with monomial denominators, systems of simultaneous equations during the first semester. Multiplication of fractions is presented before addition of fractions and there is a wealth of graphical material throughout the book. The author has made a successful attempt to eliminate problems far removed from the pupils' interests and has substituted in their places examples which have to do with present day things such as "motor cars and affairs of business."

The writer has outlined his book to fit three different view points: (1) a minimum course suitable for the slowest pupils, (2) a course to fit suggestions of the National Committee, (3) a course to conform to requirements of the College entrance examining board. All of these various phases have been thought through in the book, so that its elasticity and teachableness are strong factors in its success.

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